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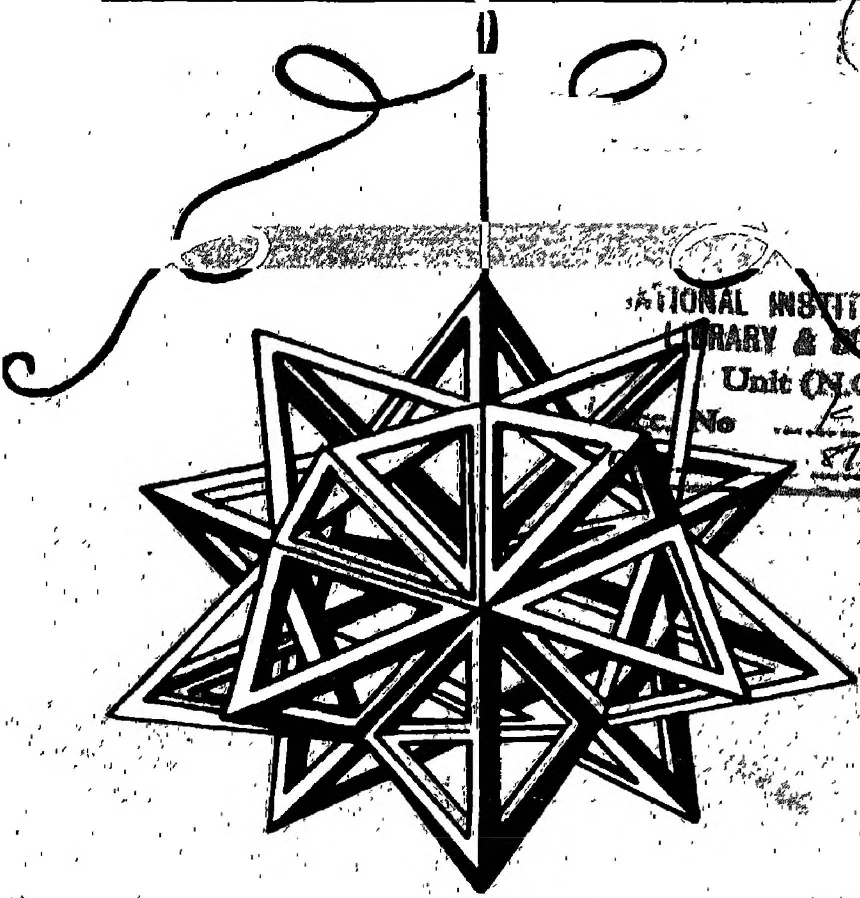

A geometrical construction
by
Leonardo da Vinci

SCHOOL SCIENCE is a quarterly journal published by the National Council of Educational Research and Training. Intended to serve teachers and students in schools with the recent developments in science and science methodology, the journal aims to serve as a forum for the exchange of experience in science education and science projects. Articles covering these aims and objectives are invited. Manuscripts, including legends for illustrations, charts, graphs, etc should be neatly typed double-spaced on uniformly-sized paper, and sent to the Editor, SCHOOL SCIENCE, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110016. Each article may not normally exceed ten typed pages.

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TO OUR CONTRIBUTORS

SCHOOL SCIENCE invites articles from teachers, acquainting students with the recent developments in science and science methodology. The articles should be addressed to Executive Editor, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110016

Pedagogy for Science Teachers

DHARM RAJ SINGH

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"The success of education to achieve its goal depends on the effectiveness of its teachers. The question of its quality and relevance are of great magnitude" concerns the author.

INDIA is a developing country. The role of education in developing countries like India is more important. The success of education to achieve its goal depends on the effectiveness of its teachers. In twentieth century the effect of Science in every field of life has gathered attention of politicians, educationists and social reformers to care for Science education for national development and prosperity. It has been felt that Science should be an integral part of general education.[1] Now the school and colleges of education have been the focus of public concern. The question of its quality and relevance are of great magnitude. The demand of deschooling has shaken our faith in the contemporary education system. Similarly cry for relevance to teacher has questioned the current teacher education practices. It is reasonable to say that schooling and teacher education programmes are interlinked and both need considerable revision.

The teacher has fundamental responsibility to generate proper learning environment after seeking possible understanding of needs, interests and capacities of the pupils. The teacher functions as a facilitator of learning, diagnostician, planner of learning activities and as an active experimenter in the process of creating and adapting innovative ideas and materials. As some one has put it, "A mediocre teacher tells, a good teacher explains, a superior teacher demonstrates and an exceptional teacher inspires."[2] We must develop such teachers who inspire. How for colleges of education are meeting this environment ? Such a question leads to many supplementary questions such as :

1. Why does a prospective teacher enter a college of education ?
2. How is training and education of a prospective teacher related to classroom needs ?
3. How can teachers gain experiences related to teaching and while teaching in schools ?

1. Education and National Development : Report of Education Commission 1964-66.
2. Rajiv Gandhi : Revamping the Educational System, *Inaugural address of the Prime Minister to the Conference of the Education Ministers of States New Delhi 29 Aug. 1985.*

4. How can teacher education operate in the context of socio-economic development of the nation ?
5. How is theoretical knowledge of pedagogy related to the classroom behaviour of the teacher and to the community needs ?

Sufficient emperical evidences are at hand to prove that contemporary teacher education programmes suffer from innumerable short comings and many astonishing things are happening in the contemporary Indian teacher education. Let us recall few of them

Colleges of education are mushrooming at an unprecedented speed perhaps at the cost of quality. The growth of teacher education institutions is shown in the following table :

teaching they themselves are experiencing something else. Many of cognitive, effective behaviours developed through professional courses have no relevance to classroom practices. Some of the workers in the field lack professional skills as they have never practised them and are hesitant to transmit them to the prospective teacher. Ultimately the prospective teacher fails to acquire professional skills as related to the classroom needs.

It is also true that some of the teacher educators are engaged, incidently in the profession, their half baked ideas end up with a change of columns in the lesson plan format. The question of studying original documents on teaching and learning is not their concern.

TABLE 1*

Primary Teacher Education Institutions

Year	1945	1950	1956	1960	1966	1972	1978	1980
No of Institutions	204	312	486	759	1548	1144	1062	1059

TABLE 2*

Secondary Teacher Education Institutions

Year	1947	1948	1955	1965	1970	1978	1980
No of Institutions	51	62	132	273	381	493	494

*Adaval S.B. : An Analytical Study of Teacher Education in India : Amitabh Prakashan Allahabad pp. 19.

Majority of colleges of education are continuing with the conventional approach and no effort has been made to provide relevant rationale for the training of the teachers. There is no alternate interplay of theory and practice. The dichotomy of theory and practice has taken a cancerous shape.

It is ironic that as future teachers are being exherted to new dimensions of learning and

With many such inadequacies, colleges of education are thriving without any concern for the quality, relevance, maintenance of international standards and preparing a prospective teacher as a professional person. But how for this situation will continue ? These are the basic questions for the community engaged in the profession.

The Nature of Science

Philosophers, scientists, theologists and others have attempted for centuries to describe the nature of Science The descriptions of the nature of Science contain certain basic commonalities. Conant for example, has written :

"As a first approximation we may say that Science emerges from the other progressive activities of man to the extent that new concepts arise from experiments and observations and the new concepts in turn lead to further experiments and observations. The testure of modern Science is the result of the interweaving of fruitful concepts. The test of a new idea is therefore is not only its success in correlating the then known facts but much more its success or failure in stimulating further experimentation or observation which in turn is fruitful This dynamic quality of Science viewed not as a practical undertaking but as development of conceptual schemes seems to me to be close to the heart of the best definition[3].

Thus the development of conceptual schemes by experiment and observation and the premise that these new conceptual schemes lead to further observation and experimentation are seen as fundamental aspects of the nature of Science. Walker says : 'The purpose of scientific thought is successful prediction, which is a prerequisite of understanding. ...Predictions are made by constructing and extrapolating conceptual models.'[4] The emphasis on observations and experimentation and the use of new concepts to stimulate further experimentation is also found extensively in the writings of other Scientists and philosophers of Science.

Strategies : Effective Science Teaching

Teaching is an interactive process, which consists of the interchange of ideas; information, observations and points of view between the teacher and learners. Kessen says about the role of teacher that the great teacher leaves the canonical expression of his material to suggest alternative approaches, to provoke independent analysis and to free the child for his wish for effortless clarity...[5].

Unfortunately today in our schools "teaching" means talking and "learning" means listening. Children in our primary schools learn to be good listeners and in secondary schools, students learn how to take notes efficiently so that they can be successful in college. It assumes that learner is essentially a sponge soaking up the knowledge offered by the teacher Therefore the teaching and learning science should be based on the developmental nature of learner and the nature of physical and life sciences too.

Course : prospective Science Teachers

What constitutes an effective course of professional education of Science teachers elicits a wide variety of opinions but the following broad fields of study or assumptions will be acceptable to most of us :

1. Study of subject matter to be taught and knowledge of appropriate methods of teaching, nature and philosophy of Science.
2. Knowledge of child psychology.

3 James B. Conant : On Understanding Science (New Haven Yale University Press 1947) p. 24

4. Marshall Walker : The Nature of Scientific Thought (Engle Wood Cliffs, New Jersey, Prentice Hall 1963) p. 13.

5. Herbert D. Thier : Teaching Elementary School Science, D.C. Heath and Company, Le[illegible] Massachusetts, U.S.A. 1970, p 131.

3. Knowledge of professional and pedagogical courses.
4. Education and its relationship to socio-economic development of nation, problems and issues of the community and
5. Study of humanistic approach.

It is most suitable time for planning of teacher education programmes in India when country-wide discussion is going on for new education policy. At this time prospective Science teacher should be prepared for the following roles :

1. Facilitator of learning
2. Life long learner
3. Learner of community problems
4. Specialist in technology of teaching
5. Promoter of National and local development programmes and
6. Dedicated worker for innovations and experimentations.

In recent years a major movement for the reform of Science teaching has developed in many countries. In USA, the Physical Sciences Study Committee has been engaged in a fundamental reppraisal of science teaching.

(An attempt had been made by NCERT to move in this direction where an orthodox experiment had been launched for the education of Science teachers). The British Council experts C R Sutton and O.H. Head in Britain and other places have taken keen interest to prepare Science teachers through Science teacher education projects. They have felt that the job of the teacher is not only to impart knowledge but also to impart desire for knowledge.

It is unfortunate that pre-service training of teachers in many instances does not reflect the changes that are consistent with the new job of teachers. These training programmes are theoretical and never bring teachers of Science face to face with the frontiers of the subject. It is keeping a teacher abreast of modern materials and pedagogical techniques best suited for the Science classroom. It is true that training methodology for Science teachers is conventional in nature when formal lectures are the main source of gaining experience and practical work has no place. To operate new approach in education of Science teachers we have to keep following assumptions in our mind :

1. Science teaching should be consistent with the nature of Science.
2. Methodology should be helpful in achieving the objectives of Science teaching.
3 The education of Science teacher should be an integration of theory and practice[6].
4. The prospective Science teacher should participate in learning alongwith the pupils.
5. Science teacher as a facilitator of learning should practise, develop and innovate such activities which can be used in the Science classroom.

The programme can be materialised under three main heads namely content, school activities and the assignments. The content will present key concepts which are needed in the classroom for teaching. These concepts are to be acquired by the students while passing through the activities. These activities are to be developed by the Science teacher. Further Science prospective teachers are to undertake some assignment which will help

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6 Cruickshank, Donald R. : Stimulation in preparing school personnel. Washington, D.C., ERIC Clearing House of Teacher Education, 1970.

them to become effective teachers. Colleges of education will need more flexible schedule and more facilities for this approach while teacher educators have to change their approach to teaching. It is hoped that when these innovative procedures will be adapted by all the teachers training colleges some fruitful result will come. Methods of teaching Science course needs experimentation with the help of scientists, Science educators and Science teachers so that a prospective Science teacher can understand and interpret Science at an appropriate level.

In existing circumstances when many changes are in the offing at the school level spontaneously teacher education programmes should incorporate new changes. It is hoped that colleges of education create an environment that practises and requires self discipline and commitment. When prospective teachers are exposed to such an environment, they discover the rewards inherent in these ideals and incorporate in their personal repertoire. The institution becomes a model and the prospective teacher becomes a self accelerated humanistic professional. A letter of Abraham Linkan to a Head master is the focal theme of this paper which is quoted below. "...Teach him, if you can, the wonder of books...but also give him quate time to ponder the eternal mystery of birds in the sky, bees in the sun and flowers on a green hill side....Teach him to listen to all men..., but teach him also to filter all he hears on a screen of truth."[7]

7. Quoted in Yojana issue 20 Vol. 23 & 24th, January 1986

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Influence of Culture in Pupils' Development of Questioning Habits in Nigeria

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Most Nigerian parents silence their children when and where they intercede in family discussions. The present study by the author on this subject highlights certain points for cultivating the habit of asking questions.

Abstract

The Influence of cultural heritage on Secondary school pupils in Nigeria has not been adequately explored especially as it affects (or inhibits ?) the habit of questioning which encourages effective classroom interaction. For this, twelve science lessons were audio-recorded, transcribed and all the questions asked by the various class pupils and their teachers' responses were isolated.

Analysis of some of the 44 questions considered along with the teachers' responses shows that the pupils questions were quite probing. Also, it was realized that the teachers did very little to encourage pupils to ask questions and this has been attributed to some inhibitive culture attributes which have been inherited from home or peer groups

Teachers, under the circumstances are being encouraged to try the best they can to encourage pupils to ask questions during lessons as it improves classroom interactions which bring about effective learning and teaching.

Introduction

For sometime now, the performance level of science candidates at the Secondary schools especially in Nigeria has been described as very low. And this has been variously blamed on the pupils, the teachers and the society at large. In an earlier study by this author-(Buseri 1985), it was suggested that teachers must share in the recrimination arising from pupils' under-achievements. This must be so as teachers have often claimed greater share of pupils' successes even where teachers did little or nothing to warrant such claims. Pupils work hard to achieve success of their own.

Even so, it has become clear that the strategies and tactics of most Nigerian science teachers have been largely expository and didactic as practical work and higher-order intellectual transactions based on formulating

and testing hypotheses, solving of problems and interpretation of data, have been very limited (Buseri 1985) In that study, it was also discovered that whereas the teachers asked seventeen times more questions including the rhetorical ones and eleven times without the rhetorical than the students, the teachers did little to encourage their students to interact in the teaching-learning process in the classroom.

This situation may be viewed from the culture of the people view-point. Since culture of a people correlates with the established ways of sharing and regulating experience that communities and groups evolve through common forms of expressions of beliefs, values and actions and means of controlling and adapting to their material lives, it is argued that any likely weaknesses in the strategies and tactics of teaching including questioning by both teacher and the student may be culturally related.

The Iowa Science and Culture project had attempted to bring out the cultural aspects of Science by trying to expose students to a coherent interweaving and cross fertilization of insights relating to pure science, technology and socio-economic phenomena. The project believed that, to become scientifically literate, a student should possess not only an understanding of the interrelationship between Science and the social, economic and physical conditions of man's life, but also awareness of where science fits into the intellectual order of things.

From this line of thought, Giddings (1966) undertook a study based on problems of minority ethnic groups of Puerto Rican and Negro origins in New York with reference to aspects affecting achievement. Giddings found from this study that family cultural factors played an important part in the achievement or potential of the children.

In a similar perspective, Maddock (1981) argued that : Science is a cultural enterprise and as such becomes part of the formal educational scheme, as societies establish, expand and change their educational systems to meet the needs of their members.

Further, the Advisory Committee on the Application of Science and Technology to Development has argued that : The growth of human intellect and skill is, in its very nature, an assisted growth. In the deepest sense, a culture serves as an amplifier of the capacities of those who participate in it. The more technologically advanced the culture, the more certainly greater is its potential for amplifying powers of the human hand, the human senses and human thought. All the same, some aspects of the Nigerian culture appear not to be relevantly geared towards the amplification of the powers of the human senses and especially the thought processes. This derives from the failure of the Nigerian culture in general to encourage young pupils to ask questions freely and on their part express their thoughts freely. It is a fact that most Nigerian parents silence their children and other younger persons when and where they intercede in family discussions. The situation is even worse if the intercession involves questioning and worst still, if the questions are probing and far reaching The tendency on the part of parents is mostly to word off these young persons. As this persists throughout childhood, young persons develop a nausea for asking questions. This situation is consequently transplanted into the classrooms.

Essence of Pupils' Questions

Responding to the question as to why teachers ask questions Marland (1975) points out that by doing so "the teacher is helping the pupil focus and clarify, and thus have thoughts and perceptions that he would not have had otherwise". Much as this thinking

is appreciably clear, it may be necessary to view it from pupils's view point. Pupils in their turn may ask questions to enable teachers focus and clarify and thus provide thoughts and perceptions which pupils may not have had otherwise for no fault of the teachers. This thinking goes to support the suggestion by Scott (1966) that "the teacher can be of significant influence in guiding and developing the thought processes of students."

Method and Materials

Twelve Science lessons comprising 5 Biology, 6 Chemistry and 1 Integrated Science were audio-recorded from 12 Secondary schools within the Rivers State of Nigeria. The Science lessons were then accurately transcribed and timed on one minute intervals. All the questions asked by the pupils and the responses given by the teachers were then isolated for analysis.

Analysis of Results

The result of the isolation process of the question provides the data given in Table 1 below.

TABLE 1

Analysis of Twelve Science Lessons

Lesson (Teacher)	*Class (form)*	*No. of pupils in class*	*Number of Pupils questions*	*Number of Teachers questions*	*Duration of lesson minutes*
T	5	28	2	27	39
T4	5	23	18	40	33
T6	4	40	—	49	29
T7	5	25	—	55	45
T8	3	35	—	31	37
T11	4	20	7	72	45
T14	5	17	3	33	44
T16	5	42	4	19	43
T22	4	40	8	53	46
T35	1	65	2	36	29
T36	3	39	—	30	34
T37	4	48	—	45	32
Total		422	44	490	456 minutes
Mean		35	3.66	40 9	38
Approximate Mean		35	4	41	38

Discussion and Findings

1. Information available from Table 1 gives the number of pupils questions as 44 as against 490 asked by the teachers. Without doubt this situation does not represent an effective involvement on the part of the pupils in the classroom learning process. It must be pointed out also that the 44 questions were asked, pupils in 7 out of the 12 classes recorded for this particular study on the basis of T2=2, T4=18, T11=7,T14=3, T16=4, T22=8, and T35=2. In effect, no pupils questions occured in 5 of the 12 classes taught by T6, T7, T8, T36 and T37.

2. Generally, the rate of occurence of pupils questions as recorded in the study was low by any known standards. All it has shown is the level of teachers insensitivity towards encouraging pupils to participate in the lessons irrespective of the teaching styles being employed. Whereas the pupils were not particularly being encouraged to ask questions to clear whatever doubts they might have, the teachers overwhelmed pupils with questions at a ratio of 10 of teachers questions to 1 by pupils.

While the failure by pupils to ask sufficient number of questions is largely attributable to the lack of encouragement by the teachers, it is necessary to ask why this should be so ? Or could it be that the teachers deliberately behave in ways that tend to minimize pupils disposition towards asking question ? The response to these will be found in the ensuing discussion.

Effects of Culture on Questions

As has been suggested in the introduction, cultural effects play a role in the perspectives of peoples and Nigerians as others and their culture is no exception. This is so as the cultural characteristics are carried into the classroom where both teachers and the pupils act out their various parts as members of the culture. The Nigerian culture is as diverse and complex as its people. Even so, there is one aspect of the Nigerian culture which is common to all linguistic groups of Nigeria and that is respect for the elders

The elders are not usually rebuked or blamed for mistakes which they commit and their authority never questioned It is this aspect of the Nigerian culture that is transplanted unto the classroom or administration. In the classroom, the teacher is inevitably the elder, the age notwithstanding As a result, whatever the teacher says is accepted. Not to accept would amount to challenging the teacher's authority and School authorities do not take kindly to such situations which they describe as "insubordination" on the part of the pupils.

This culturally imbibed characteristic is clearly evident in Schools as pupils are too much in awe to ask questions and teachers fail to encourage them to do so. Although some teachers do call on pupils to ask questions, the general attitude has never been favourable.

Teachers have been known to display almost hostile attitudes towards pupils' questions, but this was not observed by this author. Even so, this author's presence is not sufficient reason for the status quo to change to the point that many more pupils should summon courage to ask questions to clear their doubts. In the same way, the teachers appear to develop cold shoulders to the few pupils questions by way of returning question for question or encouraging other pupils to answer the questions directed to them. This latter strategy humiliates pupils and is not always a suitable one in the Nigerian situation at least, to employ.

Even so, a critical study of the pupils questions reveals that they are much more

probing than the questions asked by the teachers. Some examples of pupils questions and the responses given by the teachers are as follow :

> T4 (0.26) P · "What will happen to the eye if there is lack of sugar and protein in the aqueous and viteous humour ?
>
> T . Do you know that the eye is functioning constantly ? And it needs energy, do you know ? That is what . . why it is being supplied with it" ?

From the above teacher's response to the pupil's question, it is easy to discover his weaknesses; he did not answer the question in the best interest of the class pupils. The answer is implied rather than being made explicit. Hence, this author presupposes that pupils who look forward to a simple logical yet class-cut answer as to what may happen to the eye, left the class disappointed. The question was quite straight forward "What will happen to the eye ... ? But the teacher failed to deal with the crunch of the question. Another example is as follows:

> T35 (0.24) P : "My question is : From which part of the plant cell does the cell .. the cell have its food ?
>
> T : Now the...that plant...you know that the plant contains chlorophyll. You can see that ... you can still see it from the diagram .. The chlorophyll are inside the protoplasm and with this chlorophyll, the plants are able to make use of energy...energy from the sun and produce food. It is this food during photosynthesis that the.. em...that the plant take in".

This pupil's question above touches on an area not previously explained by the teacher. Thus, the teacher is compelled to attempt an explanation which is generalized about plants. This, however, does not satisfy the implications of the pupils' questions.

It is thought that the generally probing nature of the pupils questions prompt the teachers generally to be either evasive to the pupils questions or discourage pupils questions either wittingly or unwittingly as this can be done in various ways. One such way is to evade the question completely and ask the pupil to sit down as often noticed in some classes. Although, this did not occur during this author's period of observation and recording of the lessons, it is highly likely that this author's presence prevented such incidents from occurring (Howthorne Effect).

One other method which was used by some teachers in this sample was to ask a counter question. For example :

> T2 (0.33) P "What is an example of a bisexual flower ?
>
> T Give me an example of a bisexual flower ?

Another similar instance occurred as follows :

> T22 (0 35) P . Why is it that sodium nitrite, we do say sodium nitrite (V) ?
>
> T : Sodium what ?

In the next instance the teacher attempted to evade the question with a counter question. But then went on, probably conscious of the presence of this author in the class and switched tactics and provided an answer as follows :

> T2 (0 32) P : Excuse me Ma ! Are the flowers from the same plant ?
>
> T What is cross-pollination ? They are on different plants of the same kind".

On the whole, 14 pupils' questions out of 44 (or 31.8%) were answered by the teachers with some form of counter questions first before the deserved responses were given as the above example shows.

Another noticeable trend was the inadequacy in responses given to pupils' questions

by the sampled teachers. Some teachers' responses bordered on dismissal of the questions. This was so as most of the answers were insufficiently clear to resolve the pupils' doubts For example :

T14 (0 28) P : Excuse me, what is positive geotropic movement ?
T : Positive ... This one that you have seen.

Many similar situations occured in many other classes/lessons and were not peculiar to this study alone. These teachers' responses amounted to saying 'Go and find out what that means' in each case. This is because the responses have been generally inadequate, brief and often times implicit thus making it difficult for the pupils to appreciate the value of asking questions.

Conclusion

The study has shown that the pupils asked far fewer questions than the teachers while the teachers apparently made little or no attempts to prompt pupils to ask more questions. This situation has been attributed partly to some culturally imbibed characteristics. Even so, it has implications for Science teaching in Schools

Firstly, this can bring about frustration even in the best taught lessons if pupils should just sit listen to the teacher and watch his activities as the teacher takes all the initiatives. The second implication of failure or reluctance on the part of the pupils to ask questions during Science lessons could result in the pupils not learning at the appropriate time.

Certainly, postponement of or delayed learning does not augur well for both teachers and pupils.

It is, therefore, important that pupils, especially Nigerian pupils and others who are under such cultural strains or influences, be helped cultivate the habit of asking questions on the basis of which doubts should be put right and a good deal more learned by the pupils. Teaching has a linear progression as teachers tend to follow what they planned to teach, and it is only through questions asked by pupils and which are in turn appropriately responded to by teachers that more salient details related to the topic or lesson are divulged by the teachers.

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Goals in Mathematics Curriculum

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"There are selected mathematics educators who believe strongly in guiding students to acquire and apply facts, concepts and generalizations useful in society."

There is considerable debate pertaining to which objectives learners are to attain. The mathematics curriculum is no exception. One hears much about a return to the basics. The basics generally are perceived as emphasizing the three R's (reading, writing and arithmetic). Thus, the third R—arithmetic—has essential content for all learners to master. Within the framework of essentialism, which objectives, methods of teaching and appraisal procedures need to be in evidence ?

Instructional Management System

Instructional Management System (IMS) advocates the utilization of precise, measurable ends Vagueness and ambiguity need to be eliminated from goals instruction according to IMS tenants With clarity of intent in objectives, the teacher knows precisely which sequential ends students are to attain. Thus, learning activities may be selected by the teacher to guide pupils to achieve each objective on an individual basis. An objective needs to be attained by the student before progressing to the next sequential end. The teacher can then measure if a learner has or has not achieved a specific goal. Uncertainty on the teacher's part is not in evidence to determine if a student has mastered content necessary in goal attainment.

The Missouri Department of Elementary and Secondary Education[1] listed the following characteristics of IMS:

1. High expectations for learning. Teachers and administrators expect a high level of achievement by all students and communicate their expectations to students and parents. No students are expected to fail and the school assumes responsibility for seeing that they don't.

2. Strong leadership by building principals. The building principal is an instructional leader who participates in all phases of instruction. The principal is a visible leader of instruction, not just an office-bound administrator.

3. Emphasis on instruction in the basic skills. Since mastery of the basic skills is essential to learning in all other subjects, the effective schools make sure that students at

[1]Department of Elementary and Secondary Education, Jefferson City, Missouri, 1982.

least master the basic skills.

4. Clear-cut instructional objectives. Each teacher has specific instructional objectives within the overall curriculum which are communicated to students, parents and the general public. In effective schools, teachers and administrators—not textbooks-are clearly in charge of the curriculum and teaching activities.

5. Mastery learning and testing for mastery Students are taught, tested, retaught and retested to the extent neeessary to assure mastery of important objectives.

6. School discipline and climate. The effective schools may not be shiny and modern, but they are atleast safe, orderly and free of distractions. All teachers and students, as well as parents, know the school's expectations about behaviour and discipline.

The following are definitely not emphasized by IMS:

1. Open-ended general objectives in the mathematics curriculum.

2. Pupil-teacher planning in selecting objectives.

3. Learners in a classroom achieving at a similar/same level of progress. Each student progresses as rapidly as possible in achieving objectives.

Learning Centres and Mathematics

Educators, advocating humanism as a psychology of learning, believe that students should be involved in decision-making. Thus, the mathematics teacher, alone, does not select objectives, learning activities and evaluation procedures for students. Rather, within a flexible framework developed by the teacher, the learner may select from among alternatives which sequential activities to pursue. A learning centre approach might then be in evidence. An adequate number of centres and tasks need to be available so that the involved student may truly choose which activities to pursue and which to omit. Continuous progress must be made by the learner in completing personal suitable tasks. Each student may then achieve at a unique optimal rate of progress. Diverse objectives in mathematics may be achieved when comparing one student with another.

Choices made by learners in tasks pursued depend upon personal interests, abilities, capacity and motivation. The kinds of tasks chosen may emphasize individual or committee endeavours, an activity centred or subject matter emphasis, inductive or deductive methods as well as concrete or abstract experiences

Morris and Pai[2] wrote the following pertaining to the thinking of Carl Rogers:

> "But what are the conditions for such learning and what must the teacher do to facilitate them? Like other humanistic educators, Rogers assumes that human beings have a natural potentiality for learning and curiosity. John Holt argues that this potentiality and desire for knowledge develops spontaneously unless smothered by a repressive and punitive climate. Consequently, humanistic educators seek to remove restrictions from our schools so that the child's capacity for learning can be cultivated. They attempt to provide the child with a more supportive understanding and nonthreatening environment for self-discovered learning. For example, if Jimmy is having serious difficulty in reading, he should not be forced to recite or read aloud in front of his peers whose reactions may strengthen

[2]Van Cleve Morris and Young Pai, *Philosophy and the American School.* Boston . Houghton Mifflin Company, 1976, page 367.

his own perception of himself as a failure. Rogers believes that significant learning can be promoted by allowing children to confront various problematic situations directly. If students choose their own direction, discover their own resources, formulate their own problems, decide their own course of action and accept the consequences of their choice, significant learning can be maximized. This suggests that significant learning is not possible unless the learner's feelings and the intellect are both involved in the learning process."

Advocates of learning centres do not emphasize:

1. Precise, measurable objectives for student attainment. What is specific to measure in pupil progress may not be relevant. Interests and purposes of learners are significant but can not by any means be precisely measured

2. Teachers selecting objectives, learning activities and evaluation techniques for students.

3. A rigid, formal curriculum. Rather, input for students in curriculum development is important.

4. Each pupil being assigned the same/similar tasks as compared to other learners in the classroom.

Structure of Knowledge

Mathematics may be perceived as having considerable structure. There are selected concepts and generalizations which hold true consistently. Thus, concepts such as the following may be stressed in teaching and learning :

1. The commulative property of addition and multiplication.
2. The associative property of addition and multiplication.
3. The distributive property of multiplication over addition.
4. The identity elements for addition and multiplication.
5. The property of closure for addition and multiplication.

Key concepts and generalizations as advocated by mathematicians on the higher education level, then become objectives for students to attain on the elementary, junior high school or middle school and senior high school years

To achieve these structural ideas, the teacher of mathematics needs to have students utilize inductive methods of learning. Lecture and heavy use of explanations is not recommended. Rather, the teacher identifies problems and questions. To secure content in answer to the questions and problems, a variety of reference sources need to be utilized Answers to problematic situations come from students. Methods of learning used by students should be similar to those emphasized by professional mathematicians.

Woolfolk and Nicolich[3] wrote :

Jerome Bruner is a well-known modern cognitive theorist. Bruner has been especially interested in instruction based upon a cognitive learning perspective. He believes that teachers should provide problem situations that stimulate students to discover for themselves the structure of the subject matter. *Structure* is made up of the fundamental ideas, relationships or patterns of the subject matter, that is, the essential information. Specific facts and

[3]Anita E. Woolfolk and Lorraine McCune Nicolich, *Educational Psychology for Teachers.* Englewood Cliffs, New Jersey : Prentice Hall, Inc., 1980, page 209.

details are not part of the basic structure. However, if students really understand the basic structure they should be able to figure out many of these details on their own. Thus Bruner believes that classroom learning should take place inductively, moving from specific examples presented by the teacher to generalizations about the structure of the subject that are discovered by the students.

Structure of knowledge advocates in mathematics do not believe in :

1. Student-teacher planning as to objective the former is to attain. Rather, structural ideas need to be achieved as identified by subject matter specialists.

2. Teachers presenting subject matter deductively for learners to acquire.

3 Content for student attainment being chosen by others than professionals in the mathematics curriculum.

4. Emphasizing abstract experiences for students as compared to the concrete and semi-concrete. Sequence in learning activities must progress from manipulative (real objects and items), to the iconic (pictures, films, film-strips, slides and transparencies) to the symbolic (abstract words, letters and numerals).

Mathematics Laboratory

Mathematics laboratories philosophy in teaching and learning believe that students are active, not passive beings. Learners need to choose and select, rather than to listen to lectures and lengthy explanations of subject matter. Concrete experiences need to be at the heart of the mathematics curriculum. An adequate number of real objects need to be in the offing to stimulate student achievement. Thus, for example, objects and materials need to be in evidence from which learners may select to weigh, measure lengths and widths, determine the volume as well as find areas, perimeters and circumferences

Within the framework of concrete experiences, students use abstract learning to record weights, measurements, areas and circumferences.

Involving the mathematics laboratory concept, Ediger[4] wrote :

Pupils should have ample opportunities to experience the mathematics laboratory concept of working. The mathematics laboratory emphasizes tenets of teaching and learning such as the following :

(a) Pupils are actively involved in ongoing learning activities.

(b) A variety of experiences is in evidence so that pupils may select materials and aids necessary for problem solving.

(c) Practical experiences are emphasized for learners in that they actually measure the length, width or height of selected people and things ; weigh real objects and record their findings ; find the volume of important containers as well as determine areas of selected geometric figures.

(d) Pupils become interested in mathematics due to reality being involved in ongoing learning activities.

(e) Provision is made for individual differences since there is a variety of learning opportunities for pupils from which to select on an individual basis

(f) Meaning is attached to what is being learned since pupils individually and in committees work on tasks adjusted to their present achievement levels.

A mathematics laboratory philosophy does not advocate :

[4]Marlow Ediger, *The Elementary Curriculum, A Handbook* Kirksville, Missouri : Simpson Publishing Company, 1977, page 170.

1. A textbook methodology in teaching and learning situations.

2. Students being recipients of facts, concepts and generalizations from teachers

3. Lecture and extensive explanation approaches in teaching mathematics.

4. Abstract, symbolic learnings to the exclusion of using realia in the mathematics curriculum.

Miniature Society Concept

There are selected mathematics educators who believe strongly in guiding students to acquire and apply facts, concepts and generalizations useful in society. The community becomes an ideal place then in having learners attain understanding, skill and attitudinal goals. Thus, for example, students with appropriate readiness experience and with teacher stimulation might engage in finding unit prices for soap, cereal, flour and cake mixes, How much then does each brand name and generic brand cost per ounce or gram ? Other factors also need to be evaluated, in addition to unit pricing and that is quality within each item.

Student in a miniature society context, might determine the cost of :

1. A given number of items from a Supermarket.

2. Selected items purchased from a hardware store.

3. Items of clothing from a clothing store.

4. Cost of gasoline after buying a certain number of liters or gallons.

A miniature supermarket may be developed in the classroom. Empty cereal, fruit and vegetable as well as other containers may be placed on shelves in the classroom setting. Appropriate clearly labeled prices need to be attached to each food item. Play money may be used by learners in shopping for needed items Paper and pencil as well as the hand held calculator may be used to determine cost of a given set of items purchased, as well as change to be received from money given in payment.

John Dewey[5] wrote :

> The development within the young of the attitudes and dispositions necessary to the continuous and progressive life of a society cannot take place by direct conveyance of beliefs, emotions and knowledge. It takes place through the intermediary of the environment. The environment consists of the sum total of conditions which are concerned in the execution of the activity characteristic of a living being. The social environment consists of all the activities of fellow beings that are bound up in the carrying on of the activities of any one of its members. It is truly educative in its effect in the degree in which an individual shares or participates in some conjoint activity By doing his share in the associated activity, the individual appropriates the purpose which actuates it, becomes familiar with its methods and subject matters, acquires needed skill and is saturated with its emotional spirit.
>
> The deeper and more intimate educative formation of disposition comes, without conscious intent as the young gradually partake of the activities of the various groups to which they belong. As a society becomes more complex, however, it is found necessary to provide a special social environment which shall especially look after nurturing the capacities of the immature. Three of the more important func-

[5]John Dewey, *Democracy and Education.* New York : The Macmillan Company, 1961, page 22.

tions of this special environment are: simplifying and ordering the factors of the disposition it is wished to develop; purifying and idealizing the existing social customs; creating a wider and better balanced environment than that by which the young would be likely, if left to themselves, to be influenced.

A miniature society mathematics curriculum does not emphasize :

1. A textbook centred method of teaching mathematics.
2. A teacher initiated curriculum whereby the instructor selects objectives, learning activities and appraisal procedures for pupils.
3 Minimizing concrete, life-like experiences for students.
4. Students being recipients of content in a highly structured mathematics curriculum.

In Closing

Numerous philosophies are in evidence pertaining to goals in mathematics for learners to attain. These include :

1. IMS with its emphasis upon precise, measurable ends for learner attainment
2. Learning centres with its stress placed up students becoming quality decision makers in ongoing experiences.
3. Structure of knowledge with its advocacy of students acquiring major concepts and generalizations as identified by professional mathematicians.
4. A mathematics laboratory with emphasis placed up students using concrete materials in mathematics achievement.
5. A miniature society philosophy in which learners use mathematics in the functional real world.

Teachers and supervisors need to study and evaluate each philosophy. Ultimately, those philosophies which guide each pupil to achieve optimally should be emphasized in the mathematics curriculum.

AIDS : An Overview

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AIDS has become a burning topic of discussion these days. As many as four million people around the world may be infected with the virus thought to be the cause.

ACQUIRED immune deficiency syndrome, a new and deadly disease is fast catching an eye of common man all through the world. The number of patients is increasing exponentially and has become a burning topic of discussion these days. As many as four million people around the world may be infected with the virus thought to be the cause. Till to date, the tally of AIDS cases all over the world is said to be over 20,000 of whom 17,000 or so are in USA alone. Half of them are already dead and the other half are among awaiting their turn to die sooner or later.

Discovery

It appeard out of blue, just few years ago in 1981. Dr. Gattlieb working in a hospital near Los Angeles was treating four acute cases of *Pneumocytis pneumonia,* a rare disease, an opportunistic infection (an infection which occurs when body's immune system collapse) All above were homosexuals. Gradually occurrence of such a deadly disease came to light and often patients were reported to be suffering from sarcoma of skin, karpos's sarcoma and other fatal diseases. This was the beginning of the so called 'gay plague.' It is now realised that the number of homosexual males far exceeds others, intravenous drug abusers who often shared needles, or those who had received blood or its products where the donor was an AIDS patient.

Symptoms

The most dreaded fact about AIDS is that its initial symptoms are rather innocuous because of difficult diagnosis. Its early symptoms resemble those of less serious illness, persistent fatigue, fever, diarrhoea, night sweating, swollen lymph glands in neck, armpits and groin as well as recurring viral infections like colds, flue, herpes simplex, karpos's sarcoma and PCB like deadly diseases strike these patients.

Etiology of Virus

AIDS is etiologically associated with infection by a virus variously called Human T-lymphotropic retrovirus type III (HTLV III), Lymphoadenopathic associated virus (LAV) and recently designated as the human immuno

deficiency virus (HIV). The AIDS virus may infect particularly T-lymphocytes of a particular type called the helper or inducer subset (cells expressing T_4 antigen). Infected lymphocytes may loose their ability to function and die prematurely leading to the depletion of the cellular immune system that is characteristic of AIDS. In addition, there is compelling evidence that the AIDS virus may infect cells in the CNS, although which cells are infected in CNS is not clear. Evidence has come from the demonstration of presence of viral nucleic acid in host cells. In addition, infecting brain tissue from infected patients resulted in AIDS in primates. The Fig. 1 shows how a retrovirus replicates within a T-lymphocyte. The retrovirus interacts with the cell receptor and enters the cell by endocytosis. The retroviral reverse transcriptase becomes active once the virus enters the cells and sheds its coat. The so called proviral DNA may then integrate into the genetic material of host cells. Transcription leads to synthesis of viral protein and thus assemble into new viruses.

AIDS is now well known to prevail among homosexuals but the cause is not well established It is clear enough that transmission is through blood or semen. Scientists have long suspected that something assisted in transmission of the disease in gayman. A team of Japanese scientists have suggested role of Prostaglandins in transmission of AIDS. Prostaglandin (PGE_2), a harmone like compound is found in large amount in human semen. Body fluids other than blood, semen e.g. saliva and tears can also carry the AIDS virus HTLV III, but there is no evidence of transmission through food or casual contact.

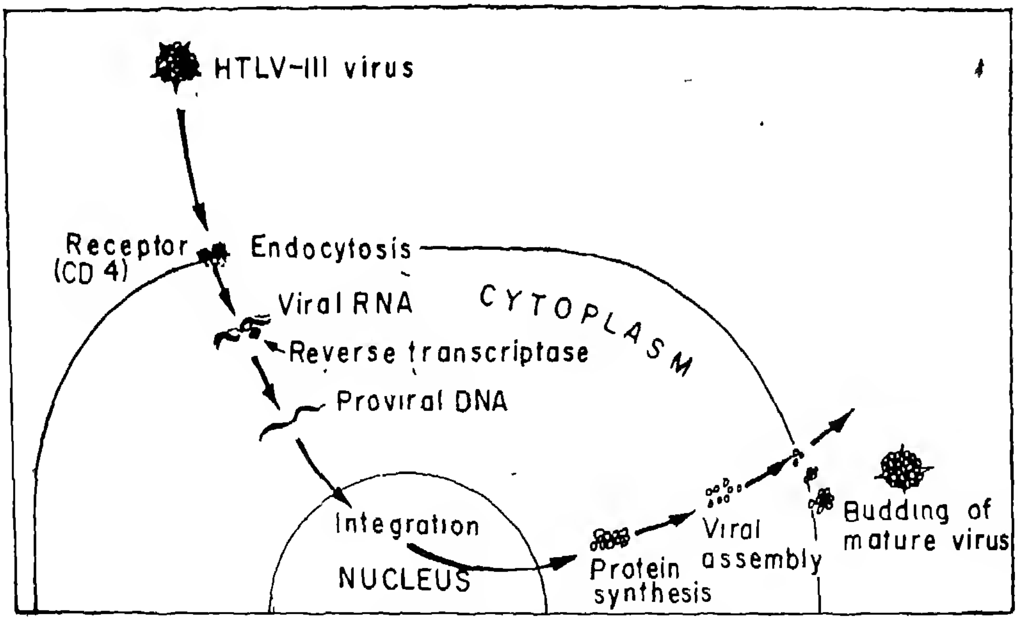

Fig. 1 : Pathway of Virus in Cell Cytoplasm

Semen is exceptionally rich in PGE_2 (60 mg/ml as against 0.001 ug/ml in other fluids). Japanese team led by Osamu Hayaishi of Osaka Medical College reported that PGE-2 being a known immuno suppressor can in some way increase the risk of contracting AIDS in homosexuals as large amounts are absorbed through the rectum during anal intercourse. This was further supported by the fact that male rats showed marked loss of immune response on getting anal infusion of PGE_2 as compared to female ones. Further, it facilitated viral multiplication in an *in vitro* application of PGE_2 to virus infected cells Effects of PGE_2 in human are yet to be cofirmed.

AIDS in India

Indian scientists also became cautious of this deadly disease after the detection of six cases of AIDS in Tamilnadu. All concerned were prostitutes between 20-30 years. None of these women showed clinical symptoms of AIDS except the one who lost weight. Their sera were subjected to enzyme linked immuno sorbent assay (ELISA) at Indian Council of Medical Research (ICMR) centre at Christian Medical College, Vellore and findings were confirmed at the Centre for Disease Control in Atlantica, Georgia. ICMR is expanding its network for surveillance of AIDS all over the country. Surveillance centres have been set up in big cities like Pune, Delhi, Bombay and Madras. Twenty five thousand kits have already been imported. ICMR is also launching a programme to train physicians with techniques in diagnosis of AIDS.

AIDS Vaccine

AIDS has taken the world by surprise. Although we still have no specific cure for disease, doctors have identified the most promising strategies for combating the virus and its devastating effects Chief contribution

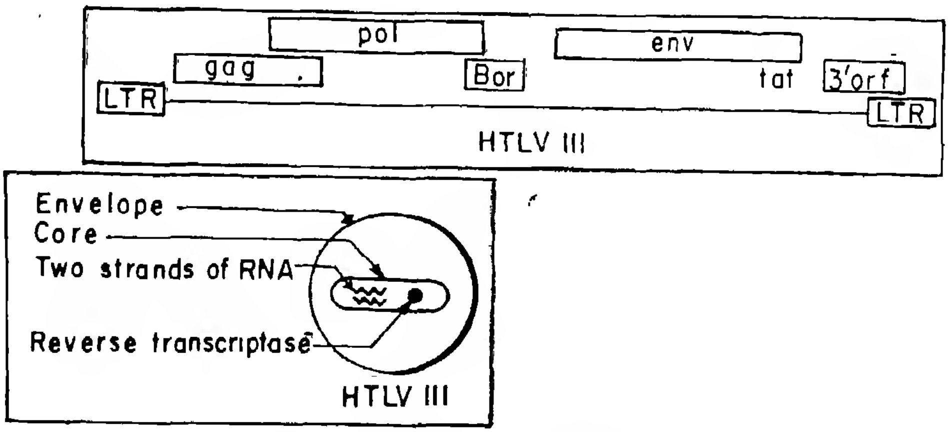

Fig. 2 : HTLV III/IIIV Gene map

towards genetic make up of virus (Fig. 2) was that of Gallo's laboratory at National Cancer Institute of Bethesda, Maryland. Scientists have reported virus 'tat' (trans activation) gene as potential target controlling virus multiplication inside host. Flossie Wong Staal and

Mandy Fisher of National Cancer Institute have reported that tat III proteins activate a specific sequence in viral genome called trans activator responsive (TAR) sequence which apparently speed up the expression of other virus genes required for viral multiplication. This was further confirmed by the fact that 'tat' less mutants could not multiply. Another team of researchers led by William Haseltine of Harvard University reported that tat III works after transcription but whether it stabilizes mRNA, increases rate of translation or perhaps help in protein assembly are still to be worked out. Part of gene responsible for killing cells is still a mystery. Suspects are 3 'orf' and 'env' gene which code for virus envelope sheath. Two teams of researchers one from US National Institute of Health and another from a company called Oncogenes have inserted the 'env' gene from the AIDS virus into vaccinia virus. 'Env' gene is important because it is responsible for a highly antigenic protein called gp 120 which induces the immune system to produce large amount of antibodies to attack the AIDS virus. It has been successful in inducting antibody formation in seven out of eight-rhesus monkeys. Neither of the teams is claiming it to be a vaccine but we hope for one in near future. □

A Triangular Problem

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Sometimes "quality" of an excellent management is noticed while experimenting something. Ajay's experiment in this paper is a unique example of its kind which may charm others for their innovative practices.

AJAY recently joined Indian Forest Department' as a Divisional Forest Officer. He was made incharge of a large and dense forest in Bharatpur district This forest occupies a large triangular piece of land. This land is decorated by beautiful trees, large and small. Three tar roads are built along its three boundaries for the trucks which come to carry timber. Ajay moved in a jeep along these roads to make a general survey of the area.

During this visit Ajay found that at one of the corners of this triangular forest there was an old temple where people from nearby town came occasionally for worship. At the other corner there was a pond. Sometimes wild beasts came there for drinking water At the third corner there was a small canteen run by a villager to serve the truck drivers and wood cutters. The road which joined the pond with the canteen was 24 km. long. The

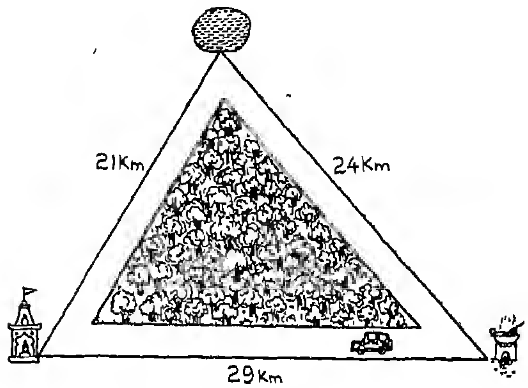

Fig. 1

road which joined the canteen with the temple was 29 km. long and the road which joined the temple with the pond was 21 km. long. Ajay was also told that the area of this forest was 200 square kilometres.

Ajay was dam pleased to see this green heaven of prosperity and he decided to show his quality of excellent management while developing and taking care of the area. For this purpose he decided to examine all the available information regarding the forest. First of all he confirmed the lengths of the roads This he could easily do while moving in the jeep at a constant speed, by noting the time required along each road (Distance= speed × time). Then came the job of finding the area of the forest. In his high school mathematics class, Ajay had learnt the

formula (Area of triangle $= 1/2$ base $\times$ height). But how can one find the height of such a large triangular piece of land ? Ajay therefore decided to find, if possible, a formula which would give area of a triangle only in terms of the lengths of sides of the traingle. This is how Ajay proceeded :

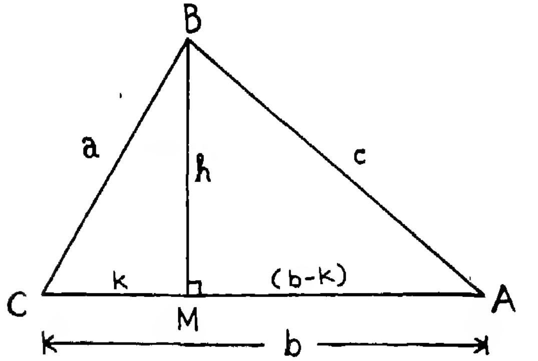

Fig. 2

In fig. 2 we see that

Area of $\triangle$ ABC $= \frac{1}{2}$ b $\times$ h ...... (1)

But $K^2 + h^2 = a^2$ ...... (2)
and $(b-K)^2 + h^2 = c^2$ ...... (3) — Pythagores theorem.

$\therefore$ equation (2) — equation (3) gives

$$K^2-(b-K)^2 = a^2-c^2$$

i.e. $K^2-b^2-K^2+2bK = a^2-c^2$

$2bK-b^2 = a^2-c^2$

$$\therefore K = \frac{a^2+b^2-c^2}{2b}$$

Putting this value of K in equation (2) we get

$$\frac{(a^2+b^2-c^2)^2}{4b^2} + h^2 = a^2$$

$$\therefore a^2-\frac{(a^2+b^2-c^2)^2}{4b^2} = h^2$$

$$\text{or} \quad \frac{4a^2b^2-(a^2+b^2-c^2)^2}{2b^2} = h^2$$

$$\text{or} \quad \frac{(2ab+a^2+b^2-c^2)(2ab-a^2-b^2+c^2)}{4b^2} = h^2$$

$$\text{Hence } h = \frac{\sqrt{(2ab+a^2+b^2-c^2)(2ab-a^2-b^2+c^2)}}{2b}$$

$\therefore$ Area of $\triangle$ ABC $= \frac{1}{2}$ bh

$$= \frac{1}{2}b\frac{\sqrt{(2ab+a^2+b^2-c^2)(2ab-a^2-b^2+c^2)}}{2b}$$

$$= \frac{1}{4}\sqrt{(2ab+a^2+b^2-c^2)(2ab-a^2-b^2+c^2)}$$

$$= \frac{1}{4}\sqrt{[(a+b)^2-c^2][c^2-(a-b)^2]}$$

$$= \frac{1}{4}\sqrt{(a+b+c)(a+b-c)(c+a-b)(c-a+b)}$$

Ajay simplified it further by putting $a+b+c =$ perimeter of triangle $= 2s$

Then,

$$a+b-c = a+b+c-2c = 2s-2c$$
$$c+a-b = c+a+b-2b = 2s-2b$$
and $$c-a+b = c+a+b-2a = 2s-2a$$

$$\therefore A = \frac{1}{4}\sqrt{(2s)(2s-2c)(2s-2b)(2s-2a)}$$
$$= \frac{1}{4}\sqrt{16(s)(s-c)(s-b)(s-a)}$$
$$= \frac{1}{4}\, 4\sqrt{s(s-a)(s-b)\,s-c)}$$
$$= \sqrt{s(s-a)(s-b)(s-c)}$$

Using this formula Ajay found the area as follows.

$$2s = 21 + 24 + 29 = 74$$
$$\therefore s = 37$$
$$\therefore A = \sqrt{37(37-21)(37-24)(37-29)}$$
$$= \sqrt{37 \times 16 \times 13 \times 8}$$
$$= 8\sqrt{37 \times 13 \times 2}$$
$$= 8\sqrt{962}$$
$$\simeq 8(31)$$
$$= 248 \text{ sq. k.m.}$$

Thus Ajay could quickly see that the area which official records gave (200 sq. k.m.) was incorrect.

The formula $A = \sqrt{s(s-a)(s-b)(s-c)}$ which was accidentally discovered by Ajay is in fact known to mathematicians since 1st century A.D. due to a person called Heron of Alexandria. We do not know how he derived this formula However, we know a lot of other interesting information about him. It was in his works that the square root of a negative number is first known to have appeared. Here we find $\sqrt{81-144}$ which is then to be $\sqrt{144-81}$, which is wrong as we know it today, (so you see even great people sometimes make mistakes). Heron however is credited for discovering perhaps the most important principle in the early development of optics which states that the path of a ray of light emitted from one object and reflected back to different object by a plane mirror is

always of minimum possible length. Heron also seems to have succeeded in reducing the solution of geometrical problems to numerical problems. Let us consider one of his problems.

Problem. If the sum of the diameter, perimeter and area of a circle is 212 find each of them taking $\pi = 3\frac{1}{7}$ Heron proceeds as follows.

$$d + 3\frac{1}{7}d + (3\frac{1}{7})\frac{d^2}{4} = 212$$

i e $\frac{11}{14}d^2 + \frac{29}{7}d = 212$

He then multiplies throughout by 154 to make the first term a perfect square.

$\therefore \frac{11}{14} \times 154\, d^2 + \frac{29}{7} \times 154\, d = 154 \times 212$

$\therefore 121\, d^2 + 638\, d = 32648$

$\therefore 121\, d^2 + 638\, d + (29)^2 = 32648 + (29)^2$

$\therefore (11\, d + 29)^2 = 32648 + (29)^2$

or $(11\, d + 29)^2 = 32648 + 841 = 33489$

$\therefore 11\, d + 29 = \sqrt{33489} = 183$

$\therefore 11\, d = 183 - 29 = 154$

$\therefore d = 14$

Now knowing d one can easily calculate the perimeter and the area.

Now let us look at Heron's formula from a different angle. In $A = \sqrt{s\,(s-a)(s-b)(s-c)}$ if s is kept constant

then $A \propto (s-a)\,(s-b)\,(s-c)$

also $(s-a) + (s-b) + (s-c) = 3s - 2s = s =$ constant

also $(s-a)$, $(s-b)$ and $(s-c)$ are each positive and three positive numbers with a constant sum give maximum product when they are equal. Hence when $(s-a) = (s-b) = (s-c)$ i e. when $a=b=c$, A will be maximum. In other words for a given perimeter an equilateral triangle has the largest area.

Now let us make the last observation. $A = \sqrt{s\,(s-a)\,(s-b)\,(s-c)}$ indicates that as soon as the lengths of three sides of a triangle are known, its area can be found out. This may make us feel that the area of a quadrilateral can also be determined if the lengths of its four sides are known. In fact once I met a person who wanted to purchase a piece of land which was not rectangular but was having the shape of an irregular quadrilateral. He had measured the lengths of its four sides and wanted me to calculate the area of that piece of land. I had to tell him that the data was not sufficient for calculating its area. I showed him the following two quadrilaterals with identical sides which did not have the same area.

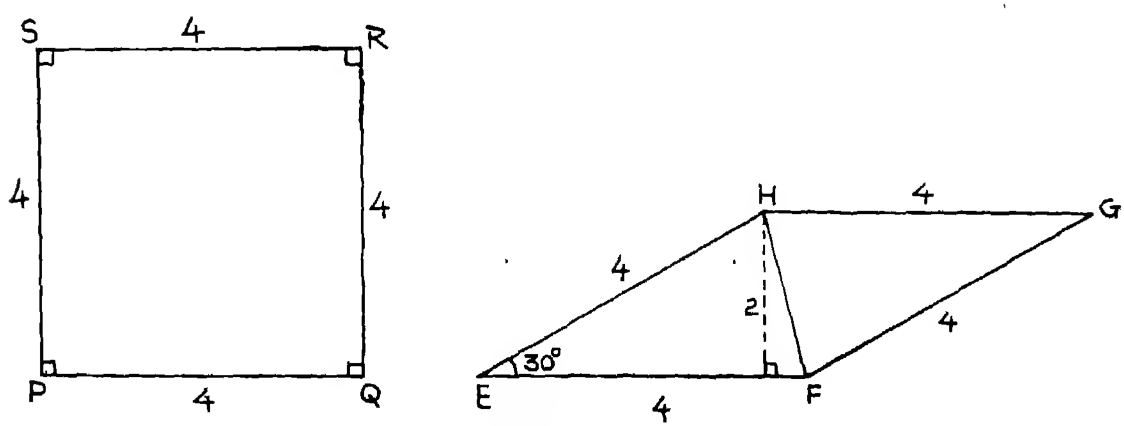

Fig. 3

From Fig. 3 it is clear that-
Area of PQRS $= (4)^2 = 16$
Area of EFGH $= 2$ (Area of $\triangle$ HEF) $= 2$ $(^1/2.4.2) = 8$
Hence area of PQRS $\neq$ Area of EFGH,
though PQ $\cong$ EF, QR $\cong$ FG, RS $\cong$ GH and PS $\cong$ EH

This difference in the behaviour of triangles and quadrilaterals is simply because of the fact that four sides cannot determine a quadrilateral uniquely whereas three sides do determine a triangle uniquely.

□

Improvised Experiment to Find Acceleration Due to Gravity

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An improvised experiment to find acceleration due to gravity as narrated by the authors here can be tried in school laboratories.

Object

To find acceleration due to gravity by using Stoke's law

Apparatus

(i) A glass tube 2.50 m long and having 2.5 cm in diameter
(ii) Stop watch
(iii) Forceps
(iv) Glass spheres of density 2.5×10^3 kg/m^3
(v) Steel spheres of density 8×10^3 kg/m^3
(vi) Nylon (plastic) spheres of density 1.15×10^3 kg/m^3
(vii) Tungsten carbide balls of density 15.5 kg/m^3

Theory

When a spherical body travels down in a viscous liquid it is subjected to the following forces :

(i) Weight of the sphere (mg) acting downward direction
(ii) Buoyant force ($v\rho_0$ g) acting in upward direction.
(iii) viscous force ($6\pi\eta$ rv) acting in up ward direction given by Stoke's law.

When the spherical ball is released from rest, the initial velocity is zero and hence the viscous force on the sphere is initially zero. As the spherical ball descends the viscous force goes on increasing. After covering some distance the downward force acting on the ball is equal to the upward force. In such condition the resultant force acting on the ball is zero and hence the spherical ball moves with constant velocity called the terminal velocity.

Now, $mg = V\rho_0 g + 6\pi\eta rv$

where m is the mass of spherical ball
ρ_0 is the density of liquid, and
η is the coefficient of viscosity.

Now, $m = \frac{4}{3}\pi r^3 \rho$

where ρ is the density of ball.
On simplifying we have,

$$v = \frac{2}{9}\frac{r^2(\rho-\rho_0)}{\eta}$$

Hence,
$$g = \frac{9 v\eta}{2(\rho-\rho_0)r^2}$$

Procedure

(1) The long glass tube is filled with clean water upto 220 cm mark.
(2) Using forcep test spherical balls of different sizes are dropped gently in water and time taken by the balls to travel a particular distance is recorded.
(3) Now the plastic balls are dropped in the water column one by one and terminal velocity is determined.
(4) Similarly terminal velocities of glass and plastic balls are determined.
(5) Now the above procedure is repeated to determine the terminal velocity of steel balls and Tungsten carbide balls.
(6) Now water is taken out and the glycerine column of 30 cm length is used to determine the terminal velocity of steel and tungsten carbide sphere.

Results

It is found that by using tungsten carbide spherical ball of 0.101 cm in size g (acceleration due to gravity) is 8.46 m/sec^2 nearer to the actual value of g 9.80 m/sec^2. So this experiment may be tried in Kendriya Vidyalaya's laboratories to find the value of g by taking a glass having only 35 cm long glycerine column.

OBSERVATION TABLE

	Sample	Size (d) cm	Density gm/cm	Time of Fall through 215 cm (in sec.)	Average Time	V m (cm/sec.)	g (cm/sec^2)	Remark
1.	Small plastic balls	0 435	1 15	38.5 , 36.0 , 39 2 37.4 , 37.0 , 36.4	37.4	5.75	36.50	Water
2.	Glass balls	0.475	2.50	4.8 , 4.9 , 4.7 5.0 , 4.5 , 4.8	4.9	43.87	23.40	Water
3.	Steel balls	0.3	8.00	2 7 , 2 5 , 2.6 2.8 , 2.6 , 2 7	2 65	81.130	23.23	Water
4.	Coal	0.207	1.373	27.6 , 30.9 , 31.0 29 9 , 29.6 , 23.1	28.8	7.47	84.00	Water
5.	Coal	0.114	1.373	44.2 , 43.4 , 50 0 39.4 , 4 45, 45.5	44.6	4.82	178.80	Water
6.	Steel balls	0 308	8 00	Time 15 sec.	15.0	2 00	477.60	Glycerine
7.	Tungsten carbide	0.101	15 50	Distance = 30 cm Time = 37 sec.	37.0	0.81	846.00	Glycerine
8.	Tungsten Carbide	0 105	15.50	Time 48 sec	48.0	0.625	603.75	Glycerine

Hence from the above results we find that Stoke's equation : $R=6\pi\eta rv$ is true only for a particular size. Coefficient of viscosity of water = 0.01 Poise , Coefficient of viscosity of glycerine = 8.5 Poise ; Density of water = 1 gm/cm^3 , Density of glycerine = 1.26 gm/cm^3

Forests, Forestry and the Youth

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There are several proofs and instances of ruthless "killing" of our forests which has led to the deforestation here and there. The author details some of the steps to prevent and stop the "murder of our jungles."

Forests form the most important single component of the terrestrial ecosystem. Their multi-dimentional role in its maintenance is well known. Their role in water and soil conservation particularly and maintaining a proper balance between various essential components of life-support system generally, is well understood. In the global context these ensure the existance and well-being of all the living things, including man on this planet.

It appears necessary to define the term "forest." Various definitions have been given to highlight one or the other aspect that were desired to be emphasised. One of these and incidently the most widely accepted one is "an area of land together with the growth on it which has been declared to be forest under a legal enactment." Ecologically forests have been defined as plant communities with dominance of phanerphytes which indicate optimal growth conditions of the area. Whatever be the definitions of this term, but for the purposes of dealing with the subject of ecosystem and the various parameters which determine it, it is enough to state that the entire vegetation forms the vital component of it Other vegetation which is more permanent and not seasonally managed like the agricultural crops constitute the greater part of it and therefore forms the most vital component of the entire life-support system in an ecosystem. It, therefore, follows that all the vegetation whether classed as forest or not is to be taken into account for the management and proper maintenance of the terrestrial ecosystem. Even in the case of aquatic ecosystem the vegetation whether rooted or floating also plays a very vital role.

Healthy Environment

From the very dawn of evolution as the life forms became more complex, the demands on environment generally and vegetation in particularly also increased. This process has, so to say, culminated in the multi-dimensional demands of man especially so in relation to the geeat strides made by him and his technology. In this process, it is only a few centuries back that proper methodologies were developed to regulate the exploitation and use of

*Based on a lecture delivered at the Deptt. of Botany, University of Kashmir, in Sept., 1986.

forest and its various products to ensure their continuance in perpetuity.

To understand it a little more it would be appropriate to define the term 'forestry.' It is also an all-embarrassing one and has been defined in various ways. One of these defines it as "the theory and practice of the constitution and management of the forests including their creation when necessary for the continuous provision of produce and services." A more prosaic definition calls it as the science and art of growing and managing trees in a manner as to ensure continuance of the stands in perpetuity.

Laws and Regulations

The practice of forestry envisages managing the crops in a manner as to cause the least disturbance in the forest ecosystem as a whole. But at the same time it allows man to utilise their produce and services to his advantage on a continuing basis in perpetuity. Demographic pressures and a phenomenal rise in the standard of living involving an unprecedented consumption of goods and growing pressures on land itself, have put the forests and the practice of forestry under great pressure and strain. The combination of these factors has resulted in a critical shrinkage of forest areas, serious imbalance and drastic changes in the flora and fauna and a general degradation of once well-stocked and dence forests. This has further been compounded by a general laxity in the enforcement of laws and regulations governing encroachments on the forest areas and wanton damage to forest wealth and public property in general.

Over the last few decades, a combination of all the above inimical factors has resulted in widespread erosion, floods, silting up of lakes, water reservoirs, rivers and even what were once fertile agricultural lands. This degradation has had a direct impact on the ecosystem as a whole, especially on some of its vital parameters. In case this downward trend is not arrested immediately, it bodes ill for the very existance of man and his many institutions of progress which he has built up so assiduously, but often so indiscriminately over the ages.

Role to Play for All

Forestry practices within the scientific limits after due cognition of the socio-economic factors obtaining locally, are quite adequate to meet this challenge. To fully ensure their success, support of the Government and effective and meaningful cooperation of the people, are the most important critical factors in this respect. It is in this context that the youth of any country, bubbling with energy and enthusiasm for a cause, constitute the most potent agency to mould the public opinion and give it a direction towards the welfare and well being of the community at large. They are admirably equiped to play a crucial and forceful part in conveying the message of forests and forestry to all the sections of the community especially those living in the vicinity of the forests. It is these people, who, though ignorant of the indirect role of forests but fully aware of their role as providers of vital commodities like fuel, timber, fodder, etc; indulge in their reckless destruction both overtly and covertly, to grab at whatever they can. The concessions and rights given to them regarding the use of forests for grazing and forest produce for their domestic use, are subject to certain regulations and restrictions. These have to be accepted in their totality in order to maintain the forests in perpetual productivity and play their vital role in ensuring proper environmental balance. This in turn will also ensure the very life-support system viz, air, water, food, etc; for the entire range of all the living things on this

planet.

Misuse of Forests

Considering the present state of forests all over, it is quite obvious that the generations of people during the last few decades, have greatly let down the generations yet to come, by reckless use and more often, misuse of all the resources in general and degradation of land and forests in particular. If this process is allowed to go unchecked, it would invitably lead to destruction of man himself alongwith all that he has stood for. Since it has gone on for a long time now and the older and middle-aged generations, both individually and collectively, have been responsible for this state of affairs, it is not expected that they will easily submit to any drastic changes in their attitudes to this matter, which alone will resurrect the otherwise hopeless situation. Having thus reached the very edge of the cliff, both the immediate and long term remedy appears to lie in the hands of the youth

Vital Mission

To enable them to accomplish urgent and vital mission, as a first step it is necessary for the youth to unite with determination to neutralise, if not eliminate altogether, the ill effects of this process by actively participating in educating the public regarding the vital role that the forests play in maintaining the environment in a proper balance. Further, conserving one of the most vital renewable resource, namely wood and its numerous derivatives has also to be appreciated in the perspective of an expanding economy to provide for the ever increasing demands of the people. Simultaneously the extremely important role of the forester in it has also to be accepted as an integral part of this process and, therefore, necessary support and help extended to him as well.

National Endeavour

To equip the youth adequately to play their constructive role in this important national endeavour, it is essential that they are adequately educated to fully appreciate the value of forests and the science of forestry. As a first step, the significance of forests as a complex living organism comprising a variety of flora and fauna, inter-dependent on each other, has to be properly understood. The different but complimentary processes at work to maintain a harmonious balance between various life forms, are to be studied and properly understood. Apart from other steps in this direction, it is necessary for them to develop a love for nature which can effectively be augmented by trekking through the sylvan surroundings, enjoying the ever-changing panorama and learning about the ways and methods of nature at work. To help them in this task it is necessary to organise youth clubs which are adequately funded and guided on proper lines by appropriate governmental or other agencies. This process will surely help in creating a forceful and effective forum. By their perseverence and zeal, they will help save the otherwise fast deteriorating situation and not let it end up as a Greek tragedy, in which every actor plays his role and the whole lot of them die in turn, leaving a deserted stage as the only mute reminder of the entire tragic episode.

Time has gone for good, one hopes, when a Socrates would be sentenced to death for "corrupting" the youth. In fact the best that any patriot can do for the good of his fellow man is to mobilise and motivate the youth to adopt and espouse the cause of the mute and dumb, but very vital components of our eco-

system to ensure a better and a safer world to live in. Such a change in the attitudes of the present day man in respect of his otherwise self-sustaining environment is essential. To remember the famous exhortation of Swami Vivekananda to the youth :

"Arise, Awake and Stop not till the Goal is Reached."

Perception of Science Teachers about Expected Performances

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This paper is a study of difference in the perception of Science teacher and supervisors about expected performances aimed to find out such differences for appropriate planning.

PERCEPTION that teachers have about teaching skills and role performances are observed as basic requirement in the effective science teaching (Lawrenz, 1980; Peters & Yaakoki, 1980). During pre-service training, roles have been assigned to Science teachers at theoretical level. Such roles are not usually performed and so there is a difference in the perceptions of Science teachers (ST) and supervisory staff (SS) about expected performances of a Science teacher. The present study aimed to find out such differences so that appropriate planning or modification can be made for teacher-education programme.

Hypothesis

There will not be found any significant difference between the perceptions of SS and ST in relation to expectations about the different dimensions of Science teaching.

Tool

Expected performance of Science teache scale (EPSTS) was developed by the investigator. This scale consisted of 80 performances under eleven dimensions, expected from Science teachers of high school.

Sample

The sample of the present study consists of randomly selected 120 Science teachers of high schools affiliated with U.P. Board of Secondary Education and 120 supervisors. These supervisors were teacher educators related with Science teaching, Science Promotion Officers and members of SISE, Uttar Pradesh. Out of these, 109 Science teachers and 94 supervisors responded.

Data Analysis

In the present study, statistical analysis was done itemwise as well as dimensionwise. Since the data was in discrete number and distribution was not normal, non-parametric

statistical technique of analysis was employed (Siegel, 1956). To find differences between two groups, Median test was applied

difference in perceptions is significant at .05 level. ST perceive classroom teaching as more important than what SS perceived where-

TABLE

Difference in Perception between SS and ST about dimensions of Science Teaching.

Sl. No.	Name of Dimension	Rank of Dimension	X^2	Direction of Difference	Level of significance
1.	Teaching-planning	9	4 103	SS > ST	.05
2.	Classroom teaching	8	4.103	ST > SS	.05
3.	Demonstration	2	0.64	ND	.05
4.	Correlation in Science	10	4.464	SS > ST	.05
5.	Home-work	1	4 275	SS > ST	05
6	Laboratory organisation	11	6.701	ST > SS	.01
7.	Practical work	5	0.311	ND	.05
8.	Co-curricular activities	6	6.37	SS > ST	.01
9.	Science library	7	4.103	SS > ST	.05
10.	Evaluation	4	0 099	ND	.05
11.	Remidial work	3	0.463	ND	.05

Result and Discussion

The result pertaining to the analysis is given in the table The table reveals that out of eleven dimensions of Science teaching, there exists no significant difference in the perceptions of ST and SS on four dimensions at .05 level. These four dimensions were Demonstration, Practical work, Evaluation and Remidial work.

On two dimensions the difference in perceptions is significant at .01 level. ST perceive laboratory organisation as more important than what SS perceived, whereas SS perceives co-curricular activities as more important than what ST perceived

As regard remaining five dimensions the as SS perceived teaching, planning, correlation in Science, Home work and Science library as more important than what ST perceived.

It is important that the classroom teaching and laboratory organisation to which ST emphasised more favourably than SS are of low rank and of very much traditional in nature. Out of those dimensions to which SS emphasized more favourably than ST, the dimension of co-curricular activities is of special mention, as the difference in the perceptions among SS and ST is maximum. In modern Science teaching, co-curricular activities are supposed to have good role in achieving the objectives of Science teaching, but visualizing no direct impact of this dimension upon the achievement in Science, perhaps ST find it less

important.

The above discussion reveals that though significant differences between the perceptions of ST and SS in relation to expectation about the different dimension of Science teaching were found but such differences were not consistant and uniform. Moreover, differences in the perceptions were not significant in case of all the dimensions Hence the null hypothesis formed in the begining has been partially accepted.

Conclusion

It is advised that during pre-service programme teacher-educators should communicate to pupil-teachers specifically about expected performances of Science teacher. Teacher-educators must organise themselves the performances before pupil-teachers in a manner in which they are expected to organise by the pupil-teachers. This will develop the proper perceptions among Science teachers about various performances of Science teachers.

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Open-ended experiments in Developing Cognitive Abilities

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Laboratory activities play a very important role in Physics and hence efforts are continuously made all over the world to improve laboratory instruction. This paper discusses open-ended approach for doing Physics experiments and examining its effectiveness by field tests.

LABORATORY activities play a very important role in Physics instruction because they are aimed to develop :

(i) Scientific knowledge, conceptual understanding and ability to apply scientific knowledge to life-situations

(ii) Skills-organisational, manipulative, communicative and constructional

(iii) Creative ability, intellectual ability, problem solving techniques, processes of Science, curiosity to know 'why', 'what' and 'how' of thing, belief in cause and effect relationships, impartial judgements, etc.

Efforts are continuously made all over the world to improve laboratory instruction. Many are of the opinion that approaches emphasizing some amount of divergent thinking and openness in the activities are more advantageous than the traditional approach to promote the above objectives. Accordingly, we have been working on open-ended approach for doing Physics experiments and examining its effectiveness by field tests.

The open-ended approach of performing experiments has been defined differently by different authors. Horowitz[1] defines openness as style of teaching involving flexibility of space, student's choice of activity, richness of learning materials involving more individuals or small group activity than large group interaction. This description compares well with our definition of open-ended experiments[2]. But pure open-ended experiments may not be feasible in a real classroom situation in a developing country like India. Hence we have suggested a guided discovery approach for doing practicals[3]. The general format for doing experiments by this approach is as follows :

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(i) Area
(ii) Topic
(iii) Pre-requisite knowledge
(iv) Apparatus and materials
(v) Outlines of the possible activities
(vi) Evaluatory questions
(vii) Suggestions by the student for further activities.

Some guidance is provided to them by suggesting outlines of the possible activities and by listing suitable evaluatory questions. In a previous project, we have developed a series of open-ended experiments according to the above format[4].

In this project[5] we have made a comparative study of the effectiveness of open-ended approach versus traditional approach for doing Physics-practicals at the P.U.C. (Higher Secondary) level. Five guided open-ended experiments were tried out in Saradavilas College and Marimallappa's Junior College of Mysore city. The sample size was limited to 92 students comprising of 66 boys and 26 girls

Procedure : To start with, an experimental and a control group of students were formed by the help of following tests.

(i) Raven's progressive matrices (Intelligence test).
(ii) Kuppuswamy's socio-economic status scale as modified by Shri Parthasarathy of Mysore University and
(iii) An achievement test prepared by us.

These tests were used to make approximately two equal homogeneous groups, the guided open-ended group (GOG) and the traditional laboratory group (TLG) among boys and girls in the two colleges. The homogenity of the groups was ascertained by calculating the F-ratios and t-values.

The two homogeneous groups worked for 38 contact hours in the laboratory during a period of one year. Many activities were done by the students on five different topics. The activities of one such topic, namely bending of light rays are briefly described below.

Students of guided open-ended group were given the following student-sheet at the beginning of the laboratory session.

STUDENT-SHEET

Roll No : Time . 10 hours
College . Date :

I. Area	Light
II Topic	To study the bending of light rays in optically transparent media
III. Pre-requisites knowledge.	Laws of refraction, critical angle, parallex
IV. Apparatus and materials	Glass slab, prism, rectangular glass tank, hollow glass prism, convex lens, plane mirror, concave mirror, pins, travelling microscope, protractor, slits, liquid, light source, wooden board, spherometer.
V. Activities	Hint : Some of the possible methods to obtain refractive index are : 1. By finding the minimum deviation angle 2. By finding apparent depth 3 By critical angle method 4 By using hollow prism 5. By using a concave mirror 6. By adjusting the volume of the liquid, etc. Use at least one method for each medium and describe the rest by discussing with other students.
VI. Evaluatory questions	1. Does the refractive index of a substance depend on the colour of light ? 2. Does the refractive index of a medium depend on the shape of the substance ?

3. It is possible to find the refractive index of glass using critical angle method by keeping the object in air ? Explain.
4. Why do the parallel rays of light converge to a point after refraction through a convex lens ?
5. On what factors does the lateral shift of the light ray depend while propagating through a glass slab ?
6. List the factors which influence the maximum deviation angle in the prism ?

VII List further activities in this topic

The students of guided open-ended group were asked to study this sheet very carefully. Some reference books were also provided to them. Relevant apparatus and materials were provided and explained to them. They were given freedom to choose the relevant activity and the necessary apparatus and materials. They were also allowed to choose the procedure they throught best.

Each student in guided open-ended group did 4 to 5 activities from the following :

I. Determination of refractive index of the transparent solid material by pin-method, shift-method, critical-angle method, spectrometer method and convex lens method ; and

II. Determination of refractive index of transparent liquid by shift method, hollow-prism method, concave mirror method and liquid lens method.

They did these activities in five laboratory sessions of two contact hours each. At the end they were asked to discuss with others about their activities and findings.

It may be pointed out that although some guidelines or hints were given to the students, the experiment remained open-ended because:

(i) The methods adopted by students were different in doing the same activity. For example, in the hollow-prism method, some students adopted the pin-method to determine 'D' the angle of minimum deviation and 'A' the refracting angle and some others followed the spectrometer method. Similarly while calculating the focal length, some students followed the plane mirror method, some followed the UV method, some obtained the image of an object at infinity and some obtained 'F' by shift method. Again while calculating the radius of curvature some used the spherometer, some used the protractor and some others adopted the Boy's method. Further,

(ii) The methodology of doing the experiment was their own.

(iii) Observational steps were not given to them.

(iv) Freedom was given for recording, tabulating and calculating their results in their own way.

(v) Different groups of students used the different transparent materials like rectangular glass slab, semi-circular glas-slab, rectangular glass tank with different quantity of liquid, lenses and mirror of different focal lengths etc.

The students of traditional laboratory group also did these experiments in five laboratory sessions of two contact hours each. They were provided with instructional sheets which contained the aim of the experiment, apparatus and materials required for the experiment, theory and procedure of the experiment, observational steps, tabular columns and essential formulae to calculate the re-

quired variables. Besides, experiments on bending of right rays in optically transparent media were demonstrated to them. Then they were asked to :

(i) Determine the refractive index 'μ' of glass by shift method using travelling microscope
(ii) Determine the 'μ' of water shift method by using travelling microscope
(iii) Determine the 'μ of given material by using a convex lens
(iv) Determine the 'μ' of liquid by liquid lens method and
(v) Determine 'μ' of the material of the prism by using spectrometer.

After the students of both the groups had done the experiments in five different topics for a period of 38 hours they were given post-achievement and creativity tests.

Achievement Test

According to Good[5], achievement is an accomplishment or proficiency in a given body of knowledge and it is a measure of the students ability in terms of standardised test results. Hence achievement test is an evaluating tool used to measure the students' performance in the cognitive domain in the beginning and end of the programme.

In this project, post-achievement test comprises of suitable questions pertaining to the activities performed. The questions were finalised after administering them to 42 students and carrying out a detailed item analysis. Out of the 98 questions, originally administered to them only 76 questions were retained for the post-achievement test. Out of this 39 questions were at knowledge level, 22 at understanding level and 15 at application level. Care was taken to see that the questions covered only those concepts which were covered in both the groups. After administering this test, the answers were scored by using a scoring sheet and a scoring key.

Creativity test : Creativity test (verbal) developed by Professor Baqer Mehdi was used in our investigation. It helped in estimating the creative abilities of the students and in making high and low creativity sub-groups.

Primary and Secondary variables

In this investigation the methods of performing practicals were considered as independent variables and the effect due to these methods on the acquisition of knowledge, understanding and application of facts, principles and concepts , development of certain creative abilities were considered as dependent variables. However there are other variables such as intelligence levels, socio-economic status levels, school achievement, age, sex, contact periods, interests of students and class instructor which may also contribute for the outcome of the investigation. So care has been taken to control these secondary variables. Accordingly the following null hypotheses have been made.

Hypotheses

It is hypothesised that no significant differences are identifiable between the GOG and the TLG :

Ho 1 : In the mean scores of post-achievement test in Physics.

Ho 2 : In the mean scores of post-creativity test.

Ho 3 : With respect to their performance in post-achievement test when the different subgroups are made according to their intelligence levels.

Ho 4 : With respect to their performance in post-achievement test when the different subgroups are made according to their socio-economic status levels.

Ho 5 : With respect to their scores in post achievement test when different subgroups are made according to their creativity levels.

Ho 6 : With respect to their scores in post achievement test when different subgroups are made according to sex.

Tools : The null hypotheses listed above have been tested by statistical methods. Null hypotheses Ho 1 and Ho 2 have been tested by 't-test' and the remaining hypotheses have been tested by 'F-test'.

Results

The results pertaining to testing of the above six hypotheses have been tabulated in the following tables.

The table shows that :

(a) Mean and standard deviation of GOG is greater than TLG on post achievement test and post creativity test

(b) High degree of positive correlation (r) between the two groups, GOG & TLG

(c) 'T' -value is significant at 0.05 level of significance for the null hypotheses Ho 1 and hence it is rejected , and

(d) 'T-value is not significant at 0.05 level of significance for the null hypotheses Ho 2 and hence it is accepted.

Creative ability can be further divided into certain primary traits like fluency, flexibility and originality These aspects have been carefully studied by making the following sub-hypotheses.

Ho2a : No significant differences are identi-

TABLE 1

Experimental approach versus achievement and creative abilities

Hypotheses	Ability	Groups	Mean	S D	r	t-value	Significance level	Remarks
Ho 1	Achievement	GOG	56 00	52.14	0 9380	6 800	0 05	Significant
		LTG	32 70	30.80				
Ho 2	Creativity	GOG	150 00	5.960	0.9590	0.8300	0 05	Not significant
		LTG	149.9	5 080				

df = degrees of freedom = 45

fiable between GOG and TLG in the mean scores in post-creativity test.

Ho2b : No significant differences are identifiable between GOG and TLG in the mean scores of flexibility in post-creativity test.

Ho2c : No significant differences are identifiable between GOG and TLG in the mean scores of originality in post creativity.

The above three sub-hypotheses also have been tested by 't-test' and the results pertaining to these hypotheses are given in table number 2.

TABLE 2

Experimental approach versus fluency, flexibility and originality

Hypotheses Abilities	Groups	Mean	S.D.	r	t-value	Significance level	Remarks
	GOG	59.28	129 8				
Ho2a Fluency				0.9290	1.820	0 05	Significant
	TLG	44.00	89.81				
	GOG	38.60	73 94				
Ho2b Flexibility				0.7380	1.030	0 05	Not significant
	TLG	31 60	51.99				
	GOG	28 85	107.6				
Ho2c Originality				0 8570	1 090	0 05	Not significant
	TLG	18.90	64 78				

degrees of freedom = 45

The above table shows that

(a) High degree of positive correlation between the two groups, GOG and TLG

(b) Mean and standard deviation of GOG is greater than those of TLG

(c) 'T'-value is significant at 0.05 level of significance for the null hypotheses Ho2a and

(d) 'T'-value is not significant at 0.05 level of significance for the null hypotheses Ho2b and Ho2c.

These results lead to the rejection of hypothesis Ho2a and acceptance of hypotheses Ho2b and Ho2c.

TABLE 3

Results on the ANOVA of post-tests for the achievement by students of high and low levels of intelligence, socio-economic status and creativity .

Variables	Hypotheses	Source	Sum of squares	df*	Mean squares	F-value	Significance level	Remarks
Intelligence	HO_3	Total	9408.75	51	—			
		Between	7311 90	3	2437.30	55 77	0 05	Significant
		Within	2097 85	48	43.7050			
Socio-Economic status	HO_4	Total	8560.98	51	—			
		Between	6038 06	3	2012.68	38.29	0.05	Significant
		Within	2522 92	48	52 5600			
Creativity	HO_5	Total	11652 9	51	—			
		Between	9780 77	3	3260.25	83.59	0.05	Significant
		Within	1872 15	48	39.0000			

df* = degree of freedom

From the above table, it can be seen that 'F-values' for the hypotheses HO_3, HO_4 and HO_5 are significant at 0.05 level of significance and hence these hypotheses are rejected.

TABLE 4

Results on the ANOVA of achievement by boys and girls

Hypotheses	Source	Sum of squares	df	Mean squares	F-value	Significance level	Remarks
HO_6	Total	16457 7	91	—			
	Between	11888.9	3	3962 98	76.33	0.05	Significant
	Within	4568 70	88	51 9170			

df* = degree of freedom

From the above table it can be seen that 'F-value' is significant for the hypothesis Ho_8 at 0.05 level of significance and hence this hypothesis is rejected.

Discussion

The rejection of the null hypotheses HO_1 shows that the superiority of GOG over TLG in acquisition of knowledge, understanding, application of certain concepts and principles in Physics.

The results on the hypotheses on creativity are interesting. Though in general creative aspects seem to be independent of the experimental approach, the rejection of Ho_2a shows slight superiority of GOG over TLG in acquiring fluency, that is, in developing the fertility of ideas.

The rejection of null hypotheses HO_3, HO_4 and HO_5 shows the superiority of GOG over TLG in a achievement of cognitive abilities for students of both high and low levels of intelligence, socio-economic status and creativity test

The results on the hypotheses HO_3, HO_4 and HO_5, also show that the two approaches guided open-ended and traditional laboratory are themselves not affected by both high and low levels of intelligence, socio-economic status and creativity of students, indicating that the experimental approach is equally applicable to all kinds of students. However the rejection of null hypotheses HO_6 shows that girls are superior to boys in their performance of post-achievement test.

The above observations lead us to conclude that (a) the guided open-ended approach is better than the traditional laboratory approach in the promotion of cognitive abilities like knowledge, understanding and application to students of both high and low levels of intelligence, socio-economic status and creativity (b) the guided open-ended approach does not have any marked superiority over traditional laboratory approach in developing creativity, except in developing fluency aspect of creativity, where a marginal superiority is indicated.

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This document prepared by the Science Education Section of Unesco for the International Bureau of Education is reproduced here as it deals with several key issues related with Science and technology apart from its focus and relevance for education.

SCIENCE and technology are an integral part of modern life. Science is essential for understanding the world through knowledge of the laws of nature. It also provides man with a tool for organizing his thinking and for classifying his experience. Science and technology can make a decisive contribution to improving our standard of living. In the meantime, education has to impart the basic scientific and technological knowledge necessary for the younger generation to carry out an increasing number of occupations, especially in the productive sector; to encourage scientific and technological vocations; as well as to foster an awareness among young people and adults of the inter-relationship between science, technology and society. The teaching of science and technology is also a powerful means of stimulating creativity among young people.

Scientific and technological development can be carried on only with the support of an interested and informed public. Educational activities and the mass media should threiefore each contribute to increasing public interest and knowledge about science and technology. Science and technology have transformed the contemporary society and the lives of individuals. Two quotations from a Unesco book vividly illustrate this situation :

> What does a person living today understand by the word "science" ? What by the word "technology" ? To a few, "science" means something vaguely important. But "technology" has a meaning foi very few people indeed. Yet, novelty has an attraction for us all, even when we cannot readily accept what is actually on offer. Many people living today have witnessed the novelty of radio, for example, evolve from the crystal set, with its lofty outdoor aerial and its sunken bucket for an "earth", to the portable transistor, via the now defunct thermionic valve.
>
> Such people have witnessed the advent of television. They have watched the landings of the moon. They can see the Olympic Games or the football World Cup Final being played in whichever country is

hosting the event. Their homes are full of gadgets which were unknown to their parents : electric toasters, coffee percolators, washing machines, vacuum cleaners, refrigerators and quartz clocks. Their pockets may contain a cigarette lighter, a ballpoint pen, a digital calculator or coins to operate the many different slot-machines, all of which have become commonplace during the course of the last half-century.

Yet this is not true all over the world. Seen in a global context, the impact of science and technology is uneven between the richer and the poorer countries. For illiterate peasants living in remote areas of developing countries, for those who live in primitive communities or who, in the urban centres, live on the fringes of society, science is a remote entity, alien to the world which surrounds them.

The Disadvantages

It is customary to emphasize the benefits that humanity has derived and may derive in the future, from science and technology, but one should also remember their adverse effects. Among these one thinks of the application of science and technology for *military purposes.*

Although the threat of nuclear war appears to overshodow all other problems, the *population explosion* is another extremely disturbing issue. The world population is at present doubling approximately every thirty-five years. The links with science and technology are clear. It is both interesting and terrifying to consider that what was apparently a beneficial aspect of science and technology the reduction of death due to disease and famine has generated over-population.

Less menacing than the nuclear bomb and rather less disturbing than the population explosion, but malign none the less, are the consequences of *environment Pollution*, and the degradation and deterioration of nature and natural resources. Better education will make the individual more aware of the advantages of technological advance.

Some Key Issues and Trends

The development of science and technology has been so rapid in recent years and their implications for humanity so profound that it is not surprising that there have been many corresponding changes in education. Many, though by no means all of the most striking changes date from the mid-1950s, when curriculum projects were established in many parts of the world to bring science courses up to date. The reasons for this upsurge of effort are well known.

Science and National Development

The United Nations Conference on Science and Technology for Development (UNCSTD), held in Vienna in 1979, drew the attention of the world to the potential contribution of science and technology to the achievement of development objectives, and to the importance of building scientific and technological capabilities in each country. Although UNCSTD did not give specific attention to education, Unesco organized a conference in 1981 which did. This Conference, on the theme "Science and technology education and national development", established a series of guidelines for science and technology education programmes at the national level, and also for international and regional action to support such activities These guidelines covered primary, secondary and post-secondary science and technology education, teacher education, non-formal and continuing education and the public understanding of science

and technology. They focused particularly on the following themes :

(i) preparing relevant curricula, materials and equipment
(ii) exchanging information and experience
(iii) research, evaluation, studies and experimentation
(iv) the training of personnel, particularly teachers
(v) the dissemination of information on these programmes and activities
(vi) the mobilization of resources (human, material and financial)
(vii) the formation of national groups for the development of science and technology education.

Relevance of Education

Prior to these two conferences, several countries were already trying to make science and technology curricula more "relevant". The following measures were mentioned :

(i) Education must reflect "real" science and technology. The educational reforms carried out in the 1950s and 1960s resulted in a major up-dating of science courses. However, there is now a need to introduce new content which reflects more recent progress.
(ii) Science and technology education should relate to the learners. Psychologists and educators, working together, are providing valuable guidelines for science courses which are appropriate to the learners' age and background.
(iii) Science and technology education should be linked with the world outside the classroom, through work experience if necessary. There must also be a better match between the products of education and the opportunities available for employment.
(iv) From the educational point of view, the child's immediate environment is an ideal starting point for science and technology education programmes. Knowledge of the environment must be linked with the availability of food, energy and mineral resources, both now and in the future.

Future Human Needs

Over 300 people from seventy countries attended a conference on "science and technology education and future human needs" in August 1985. Its purpose was to identify practical ways in which science and technology education could be made more relevant to the needs of society in the following eight areas of concern : health, food and agriculture, energy resources, land, water and mineral resources, industry and technology, the environment; information transfer and technology, ethics and social responsibility.

One outcome of the Conference will be the publication by Unesco of a series of nine books—one of them providing a general introduction to the Conference theme and the others each covering one of the eight topics mentioned above.

Science for All

In many parts of the world science and technology education policies are being renewed. Governments are concerned that every citizen should receive education in science and technology. In Canada, for example, the report on "Science for every student" has redefined the goals of science education The education system should train a selected elite for research and development, especially in industry, and at the same time give all citizens

a broad "scientific literacy". In the United Kingdom, this is being done at the secondary level.

In Asia, a regional meeting with participants from nineteen countries produced a report *Science for all*—"all" refers not only to school children, but also to out-of-school children and youth, including those who should have been in schools but were not, the work force (including vast numbers of illiterates); and the educated adult section of the population.

The issue of science and technology education for all has many implications. One of these is that, in many countries, girls do not have as great an access to science education as boys and, therefore, women do not have the same possibilities for careers in science as men This issue has been considered in several meetings recently, notably those organized by the "Girls and Science and Technology" (GASAT) movement.

Low-cost Teaching Material

A feature of modern science and technology education is that it has an experimental and practical basis and the separation of theory from practical lessons—prevalent in the past—is slowly diminishing.

Currently there is renewed interest in the use of equipment that has not been specifically designed for teaching. For science teaching in primary schools, the main function of materials and equipment is to be exploied and to help exploration. Thus, for young children, there is a positive virtue in familiar materials. However, collection and storage of such objects can be time-consuming. Providing primary schools with kits of simple equipment enhances the practical resources for science teaching.

In many countries, the local production of low-cost equipment is essential, both for educational and for economic reasons The ideal arrangement is to have the designer of equipment and the curriculum specialists working closely together. Some countries have recently established science education centres where equipment is "tailor-made" for the science curriculum in the schools.

Educational Technology

The use of radio and television programmes, slide/tape presentations, programmed learning, films and multi-media packages of various kinds have been on the science education scene for some twenty years What is new, however, is the rapidity with which the use of the micro-computer has come to occupy the centre of the educational stage and the profound influence that its advent is having on science and technology teaching in many countries. At a conference on "communicating physics" (Duisberg, Federal Republic of Germany, 1985), the most important uses of micro-computers in physics education were classified as follows (not necessarily in order of importance) :

(i) *Interface experiments* An apparatus is connected to a micro-computer which processes data directly and gives the results in numerical or graphic form.

(ii) *Simulation*. The demonstration of physical phenomena which may otherwise be difficult to visualize (change of time-scale; pictorial representation of tiny objects; graphic representation of complex processes, etc.).

(iii) *Computer interactive video discs*. A video disc which treats a certain problem is supplemented with computer software which enables the student to: test his own understanding of the subject; search the video-disc for new

content, request the computer for additional help; let the computer decide what help should be given as a result of the student's response to a "prompt".

(iv) *Computer guided video films.* The purpose of such films (which still require further development) is to: combine computer models with real situations; visualize complicated phenomena; save time on long calculations

(v) *Computer graphics.* The computer graphics may be static (curves, bar, charts, models) or representing a process (representation of time changes in a real process).

(vi) *The micro-computer as a visual aid.* Some promising experiments have been carried out on the use of the micro-computer in giving a lecture; it can also play the combined role of overhead projector and slide projector.

The list could be generalized to the teaching of other scientific disciplines and also to integrated courses in science and technology education

Activities for computer-assisted instruction should be selected carefully in relation to the particular learning involved. One example, taken from primary school mathematics, identifies three categories of such activities.

— *Concept re-inforcement* has the feature that a concept or an idea that has already been introduced or taught is used embedded in the activity, thus reinforcing what the child has learned.

— *Concept demonstration* implies that the procedure for input and processing are probably known to the child. It is the output that illustrates a mathematical relationship. In studying the data that are generated, the child discovers or observes an important mathematical relationship or concept.

— *In problem solving*, the calculator or computer gives the children a tool to explore, to test and eventually to formulate a solution to a problem In this case, a "problem" is taken to be a new situation or one for which the child does not have a pre-determined method of solution.

At this juncture, it should be pointed out that, although the cost of computer technology is declining constantly, at the present time it is prohibitively expensive for many developing countries. In such situations simpler educational tools should be used before such technology is considered Some delegates from developing countries attending a recent international conference felt that the time was not yet ripe to introduce computer learning in their countries because of the expense and because neither pupils nor teachers were ready to handle such technology. This, however, is not true of the pocket calculator which is now inexpensive and widely available. It could have a profound effect upon the teaching of mathematics and science if only teachers could be pursuaded to let young children use it.

Other rapidly developing technologies of considerable potential in science teaching include the use of video recordings. New cameras which incorporate a light-weight cassette recorder are now available and this makes field work very simple indeed. It has also recently become possible to do "time lapse" photography with a video camera. The popularity of computer games has meant that gaming and role playing techniques are also being more widely used in science teaching.

Recent Developments

Integrated science courses have developed rapidly in recent years. During the last decade, science has been introduced into the curricula of primary schools in many countries. There are several reasons for this : (a) primary education may be the only opportunity for learning science for the majority of children; (b) children form their ideas of the world at a very early age and there is a need for these ideas to be moulded by a scientific and positive attitude; (c) young children should become aware of simple applications of science in nutrition, health and hygiene and in local agriculture. Although there could be doubt as to whether teachers and children are ready for such an introduction, there are specific cases of the successful introduction of technology, particularly where it was linked with the local environment and also with practical work such as handicrafts, cookery and needlework, woodwork, metal-work and building.

Science courses at the primary school are almost always integrated (or perhaps "undifferentiated" would be a better term), centred on topics and themes which are closely related to the children's interests, everyday life and environment. Usually they have been developed locally in the country or region where they are to be used. Almost all primary school science courses are based on direct pupil experience with local materials. They tend to emphasize observation, inquiry, the building up of simple science concepts, and an awareness and exploration of the local environment.

Such courses imply a major shift in the role of the teacher—from purveyor of information to facilitator of learning experiences. It is this change in role—different from that accepted in the rest of the teacher's work—which poses a major problem in effectively introducing science courses into primary education. Attempts are being made in many countries, through a variety of strategies, to introduce primary school-teachers (and teachers-in-training) into effective ways of teaching science.

At the lower secondary level a need has been felt for science courses which are of real interest to pupils and which make a contribution to their general education. In many developing countries, such courses may be the last formal education the pupils receive and attempts are made to cover a range of topics of direct relevance to the pupil's day-to-day experience The courses designed for this level are still, as at the primary level, based on the extensive use of simple equipment and tangible materials. Furthermore, there is, in many courses, an emphasis on depth in the coverage of a particular topic rather than an attempt to cover a very extensive range of topics which characterized the old general science course.

Integrated science courses for both primary and lower secondary school are organized in a variety of ways. In some countries a "concentric" organization has been adopted in which major topics and concepts are explored and developed in greater depth over a period of several years Such topics might include aspects of human biology, food and nutrition, health, means of locomotion and transport, exploration of the local environment, clothing and shelter, energy and its transformations, the nature of air, water and soil, the earth and the universe. Another form of organization is to arrange material in "modules"—units of work which pupils can study in groups or individually. There is a sequence in the modules from one year to the next, but the order of the modules within any one year can be modified

Integrated and interdisciplinary courses are also being developed for the ***upper levels of secondary schooling***. These may be "socially

relevant" courses for pupils who do not intend to specialize further in science or courses which supplement those in the basic science disciplines by focusing on issues concerning science in a social context.

Basic Sciences

The reform movement in science and technology education was centred, during the 1950s and 1960s, on modernization of the teaching of the basic science disciplines—physics, chemistry and biology. There were also some projects based on the earth and space sciences. One of the major aims of these reforms was centred on content. Attempts were made to decide what new content should be introduced and what old material should be deleted A major goal was to restore the primacy of subject matter in the educational process. Scientists—who were the subject matter specialists—played a fundamental role in re-thinking both content and approaches. An attempt was made to have the content reflect the structure of the discipline itself. The reform projects usually stayed within the traditional boundaries of physics, chemistry and biology. It must be said, however, that it was in the very process of analysing content that the artificiality of the boundaries between the disciplines became obvious, anticipating the emphasis that would be given in later projects to inter-disciplinary and integrated approaches.

An emphasis was also given in these projects to the "processes" of sciences, presenting them as systems of inquiry rather than as stable bodies of knowledge. They paid less attention to the learning of facts and promoted, instead, active participation and discovery on the part of the student. Emphasis was placed on the students coming to grips with phenomena directly through new laboratory and field experiences in which they were encouraged to discover ideas for themselves in the same spirit and with the same approaches used by scientists. New materials were developed for learning and teaching. In-service courses were provided for teachers to initiate them into these new approaches.

In general terms, these trends have continued during the last decade. As science advances, continuous effort is needed and is being made to reflect in a meaningful way the content of "real" science in schools. Advances in agriculture and medicine and the advent of bio-technology, have their implications for courses in chemistry as does the burgeoning growth of synthetic materials, which are increasingly taking the place of natural fibres and of such minerals as lead, copper and iron.

At the same time, physical insights into atomic structure and the concept of "energy levels" have clarified the nature of "bonding" and have shed light on the fundamental issues of molecular structure. The extent to which these newer concepts can be built into school courses will depend on the maturity of the learners and the level of sophistication of the teachers.

As previously mentioned, recent advances in science have resulted in new interdisciplinary fields, information theory applied to biochemistry and genetics; physical methods used in astronomy, geology, chemistry, etc. Because of the importance of these new interdisciplinary fields, it is becoming increasingly necessary to establish better co-ordination and articulation between the teaching of the basic disciplines. The heavy dependence of physics upon mathematical representation also places a responsibility upon the respective subject teachers to work in harmony in tackling the issues of curriculum renewal.

Mathematics Education

The democratization of schooling—ranging from near-universal primary education in the developing countries to universal secondary education in the most industrialized—has caused a situation in which mathematics programmes which were originally developed for a selected group of pupils are now found too difficult for this broader population. Thus, societies are again examining their goals for mathematics teaching and asking what kind of mathematics programme is best suited for the needs of the majority.

Mathematics as taught in schools is now seen to be much more dependent upon the social and cultural life of a country. These conditions, in turn, should determine the way mathematics is taught in the schools. Mathematics permeates all of society and thus it might be expected that the mathematics learned in school will enable the learners to apply mathematics in solving the problems they encounter after they leave school. But recent evaluations have found this not to be the case; mathematics practised in the market place is different from that learned in schools, and those leaving school are unable to use their formal mathematics knowledge to solve practical problems. This implies that problem-solving in schools must be taught in real contexts if the skill is to be transferred to situations in later life.

Individuals will encounter the use of mathematics in three broad contexts : (a) in the context of their private life; (b) in the context of their working life; and (c) in the wider context of the social, economic and political life of the country of which they are citizens.

Some basic mathematical skills are needed simply to get by in life. Others are needed and used at one's place of work. The scope of these, obviously, depends upon the job. Some jobs call for only modest mathematical skills while others can be immensely demanding. In the wider context, an intelligent appreciation of a person's social, economic and political life is scarcely possible unless a reasonable level of mathematical literacy has been attained.

What are the implications for mathematical education of these three broad contexts of use ?

There is no fundamental difference between the nature of the mathematical education required for daily life, its use at the place of work or for observing and taking an intelligent part in the social, economic and political life of the community and of the nation. In all three contexts, the individual encounters problems of varying complexity. Thus, there is no conflict in designing a mathematics programme which will meet the needs of young people whether they pursue a mathematics-based career or not, except in the duration of studies.

In school, no particular mathematical topic is important in itself. The importance of a mathematical topic derives from its potential capacity to serve the needs at issue, whatever they may be. This calls in question the conventional method of defining curricula only in terms of topics, concepts and skills.

Such considerations led a meeting of mathematics educators to recommend a gradual approach to developing curricula in terms of different situations that call for relevant mathematics. The situations should be chosen and presented in a variety of ways that would ensure many different aspects of mathematics being called into play.

Therefore, participants agreed that for the immediate future, a programme of mathematics education in primary schools should be to develop the ability to use numbers in situations that arise in daily life—and that as the students progress in their studies, the scope

and complexity of the applications should increase. In the long term, secondary-school curricula should be reorganized to include situations from everyday life and from other fields of study. But due to existing structures and to available human and material resources it is necessary to think in terms of progressive steps. Hence, as a first step, part of secondary-school time should be allotted to project work involving an integration of the science and mathematics.

Another reason to concentrate on teaching mathematics as a process, rather than a product to be learnt, was mentioned earlier—computers and calculators. The widespread use of pocket calculators as to redefine basic numeracy—it surely cannot now mean "knowing sums by heart". And with microcomputer programmes capable of algebraic manipulation, complex graphics and integration of functions, what skills are needed in schools mathematics? The ability to analyse a situation and then to use appropriate mathematical skills is needed now more than ever before.

Technology Education

As outlined at the beginning of this article, "science" and "technology", while closely inter-related, differ fundamentally both with regard to their motivation, their process and their product. While the teaching of science in schools has a relatively long history, the teaching of technology as such, in most countries, is recent. The teaching of technology has antecedents in technical training and in the teaching of the applications of science, but there is now a growing awareness that technology education, linked with science education, must find a place in the general education of all children.

Out-of-school Education

It is generally accepted that a great opportunity is lost when the teaching of science and technology is confined to the laboratory and classroom Furthermore, in many developing countries there are large numbers of young people and adults who do not benefit from formal education. Hence programmes for non-formal and out-of-school science and technology education, especially in relation to development, have an important role to play in the community as a whole.

These programmes should be conceived with the specific needs of the target groups in mind. They may aim to reinforce the teaching of science and technology in schools and promote creativity and interest in young people. They might also focus on scientific literacy, on the science education of adults and on promotion of public understanding in science and technology.

Out-of-school scientific and technological activities take various forms. In some countries, activities are organized by science clubs, technical and nature clubs, "pioneer palaces", science teachers associations, junior academies of science and so forth. The content and methods of out-of-school science and technology education activities depend greatly upon the availability of human and material resources. Activities may include science fairs, youth science congress, science summer camps, independent research projects and science and mathematics olympiads. The olympiads are growing in popularity in many countries because they provide links between the prescribed school curriculum and out-of-school activities.

The most valuable out-of-school science and technology education is that which is flexibly organized and linked with community prob

lems, as in agriculture, industry and the environment. Activities may be carried out in co-operation with organizations, institutions and projects concerned with community development.

Non-formal science education

Non-formal science education for adults is conducted through the facilities of science museums, popular science centres, open universities, mobile science exhibitions, etc. The mass media—cinema, press, radio, television—are important means for the promotion of non-formal science and technology education. There are, however, limitations to the value of the mass media These arise from the fact that the general public is difficult to define with the result that programmes risk being too broad and superficial. Moreover, broadcasting time is often too limited for the adequate treatment of important science and technology issues.

One of the key problems in promoting and developing such programmes is that of identifying and training leaders and organizers to work in this field. An international symposium on the training of those responsible for out-of-school scientific activities (Minsk, Byelorussian SSR, 1985) concluded that training of various types was needed appropriate to the wide range of personnel involved in out-of-school activities such as teachers, scientists, museum curators, journalists, etc. It was recognized that, while the form of training varies from country to country, in most countries it is inadequate in both quantity and quality At the national level, training courses need to be organized—some on a full-time and others on a part-time basis. On-the-job training is also appropriate for such personnel, and training manuals and other resource materials need to be prepared.

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Teaching the Science Prone Creatively

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What is the role of the Science teachers in the stimulation of students with high ability in science? Each Science teacher must seek answer to this question within himself, questions the author in this paper.

THE phenomenon of rapid technological revolution is readily and widely acknowledged. To understand the technique of this revolution, we shall need deep and original creative minds. Much of our future—not the far future-depends upon the high level science ability of children now in school. How can we develop procedures, scientific situations and the type of learning milieu that encourages young people to develop this ability creatively? One's uniqueness is explained in terms of his ability to do and his capacity for uniqueness in terms of his ability to create. Obviously, one becomes a mathematician by mathematizing, a scientist by sciencing. And sooner he does mathematics or science, the sooner he creates; the sooner he actually becomes a mathematician or scientist. It seems that the type of education in which the youngster has an opportunity to create fits our science prone students who are expected to become our "doers", our "creative minds", our innovators and inventors and our originators in science.

Certainly it is obligatory for young people to study textbooks and to repeat experiments via laboratory, for the basic scientific knowledge gained is essential to the preparation of future scientists. But it is hardly sufficient. To originate, boys and girls must have opportunity to create on their level. This implies both time and motivation, within an encouraging school climate. These in turn imply a teaching method which recognises pupils' strengths and abilities as well as their weaknesses and lack of experience. How often are such learning activities provided in science classes to encourage such creativity? Let us discuss the methods of dealing with creative minds under the rubric of "science proneness." The term appears appropriate because "gifted", "rapid learners," "science talented" and the like have both a qualitative and quantitative difference in the students we are trying to assess.

Nature of Science Proneness

While "science proneness" refers to high ability in science a student with high ability in science is referred to as being "science prone." It may be assumed that high ability in science will be expressed most favourably

in the most favourable environment. As a working hypothesis on the nature of science proneness we may assume that whether or not high ability in science can be identified as a hereditary factor, whether or not it can be identified by testing devices, it will still be exhibited at its highest level in the most favourable environment. Let us study this working hypothesis in the light of what makes a scientist.

Observations of research scientists at work reveal that they are generally characterised with high verbal ability and high mathematical ability. These abilities called genetic factors appear to have a relationship to high intelligence and may have a primary base in heredity. Genetic factors are usually necessary but not sufficient for success in science because the organism is a product of its heredity and its environment. We can recognise the hereditary components and modify the environmental ones. The more stimulating the environment, short of pressure, the greater will be the realisation of the individual's capacity. Different students may perceive the same environment differently. Stimulation is a matter of what an individual can stand in terms of his present status and capacity.

Do these characteristics we call genetic factors assure success in scientific research? Acquisition of a Ph.D. in science is an acceptable index of commitment to scientific research though not necessarily of high success in such research. High conventional IQ scores do not necessarily indicate high creativity. Pupils with quite average IQs, because of special interests and certain personality tendencies, may be quite creative. A high IQ is a desirable but not a determining factor in screening potential scientists. Certainly, an acceptable criterion for exceptional performance in science must be sought outside the general sphere of intelligence. Apparently there are forces other than intelligence at work leading to exceptional achievement in science, such as predisposing factors, originality or creativity. Let us discuss predisposing factors first.

The characteristics relating to predisposing factors are persistence and questing. Persistence includes at least three attitudes on a given problem. A marked willingness to spend time, beyond the limit ; a willingness to withstand discomfort of missing lunch hours, being fatigued and strained or having minor illness; and a willingness to realise failure as a way to success. The attribute of questing is shown when the general authority in the given field of scholarship is challenged until the reliability and validity of that authority is ascertained. Experience attests to the fact that in addition to genetic and predisposing factors, activating factors, opportunities for advanced training and contact with inspirational teachers operate in the making of a scientist. Without activation, potentialities may be lost or turned to other areas.

As a result of our study of what makes a scientist, our working hypothesis on the nature of science proneness may be stated as : High ability in science is based on the interaction of several factors—genetic, predisposing and activating. All three factors are generally necessary to the development of high ability in science ; no one factor is sufficient in itself.

Who might become creative scientists, who might almost surely will not, no matter what their hopes or perseverance are. It is still believed that the limits of what one may do or become are set by heredity. The truth is that we do not know-nor is there any way of knowing-what those limits are. For example an intelligence does not measure inherited potential ; it merely indicates the present degree of development of that potential. Today the conclusion is that what an individual inherits is a range of capacities to respond to a variety of environments-what that response

will be depends upon how the child is treated in school and how he reacts to that treatment. The environment determines, to a marked extent, the degree to which the innate capacities are realised and the way in which they are utilised.

Whether one becomes a creative scientist is influenced by genetic factors, but one's values and motivations are the result of interacting influences of predisposing and activating factors. One's success in science depends to a large extent on his ability to adapt his behaviour to various situations and people to which he has been exposed. The teacher who accepts this view will be inclined to study the pupil in terms of his present status, how it was achieved and how to provide him with situations that will be personally stimulating and meaningful. It is in adapting learning experiences to the needs of individual pupils that the teacher capitalises on the interaction of several factors—genetic, predisposing and activating. Let us study the relative importance of these factors to access who might become creative scientists and who might not.

Relative Importance of Factors

Pupils with high mathematical and verbal abilities are more likely to become future scientists. Why not all pupils with these abilities and with high IQs choose science as a career ? Not all able students become scientists ; nor they are needed either. We need competent people in all areas of human activity. Some students have no interest in science ; no matter what attempts are made to motivate learning of science. How it came about ; it would be interesting to explore. Others who seem interested in science do not have this interest sustained , other areas of study are competing for their interests. The genetic factors are a necessary but obviously insufficient condition for selection of a career in science. What, then, is the "face validity" of these genetic factors which separate those who might become creative scientist from those who almost surely will not. A "base level" of the genetic factor can be set operationally at high I.Q. score, high reading score and high arithmetic score at high school level. These scores are followed by high academic achievement in science and high overall scholastic achievement. It is expected that this trend of abilities at high school level will not simply be maintained, but exploited to its fullest at college level.

Any continued observation of pupils in the process of learning science soon leads to the fact that genetic factors or intelligence for that matter are not enough for success in science ; predisposing factors are equally important in assessing the emotional commitment of pupils to science. Clearly, a high attendance record, a high interest in science hobby, a wide range of interests in science activities, a high tendency to undertake science projects and sticking to them, a high tendency to make extensive use of laboratory and library, a high drive to go ahead, a high tendency to ask original questions mean a high emotional commitment of these pupils to science. To be a creative future scientist, a student must have both factors ; genetic as well as predisposing ; no single factor is a complete determinant. It seems reasonable to assume that those with high genetic and predisposing factors tend to be successful in the modern competitive endeavour of science.

It is experienced, all other things being equal (they never are, of course, but dealing with factors one at a time is useful means of analysis), some students who do not spend as much time as others in laboratory, who show average scholastic attainment and who appear a bit lazy, bloom later. The goals of such students crystalise later. Perhaps their teachers

could not inspire them or interest them sufficiently. Or perhaps their teachers were wanting and not they. Here lies the importance of activating factors.

The inspirational teacher has a positive effect on science prone students in terms of arousal of intellectual curiosity, willingness to work beyond normal school hours, a questing attitude, persistence in completing a task and doing a creative work. Such a teacher must have a broad knowledge of his subject, possess a contagious enthusiasm in presenting scientific ideas and be able to provide every opportunity to the individual science prone students : to identify and state a problem ; to ask thought-provoking questions during or after a lecture, discussion or laboratory period ; to read more advanced books and publications to explore new knowledge to modify or reject one's original idea without ridicule ; to feel free in a problem of creative potential ; to receive equal recognition for creative thinking as for achievement of rote memory ; to think divergently rather than conforming to the established fact and to do independent study and research.

Programme for Science Prone

Stimulating the science prone by providing them the opportunity to develop to their fullest does not mean giving them more course work or intensifying the acquisition of knowledge through lecture and text ; it does not mean covering more material but uncovering it through the best teaching procedure. The teacher. in other words, "teaches less so that the learner may learn more." Carried into educational thinking it would mean that science and mathematics are not merely a study to pass the examination but an opportunity to invent, to imagine, to discover, to aspire sometimes to succeed but sometimes to face failure in a worthy quest. Carried into practice this would mean creating special opportunities for all students including the science prone so that each develops his potentialities to the fullest , it does not necessarily mean identical programming. Some educators wonder whether special attention to the able is democratic. The basic concept of democratic education is equal opportunity to develop to one's fullest potential and not identical exposure for all.

While classes composed wholly of science prone students cannot often be organised, classes of normal students including the science prone, can be organised and taught by the best methods available. When all students study together, special pains must be taken that the science prone student is not ignored. The programme of the science prone student should be judicious blend of regular work plus special works that are matched to his abilities. During regular classwork, these boys and girls can and should do more ; this includes differentiated assignments, differentiated reading, differentiated laboratory and field work and differentiated testing. The greatest help that may be given to the science prone student is the opportunity to undertake original research work as an out growth of regular classwork before, during or after school hours.

Science prone students can also be given special responsibilities of preparing and presenting demonstrations, supervising laboratory work, organising special projects such as science fair, field trip or science hobbies and arranging talks of the eminent scientists for latest knowledge and career opportunities in the field of science. This is how they will explore their abilities, exploit their interests and develop the qualities of leadership.

Teaching the Science Prone

The successful adjustment of science prone students is primarily due to highly able and

involved teachers especially selected for their concern and their sympathetic and understanding efforts with these students. Such a teacher knows that young scientists-to-be are developed best when they do science and mathematics as against when they are taught to cover the course material. As stated earlier for exceptional performance in science, forces other than intelligence at work are, originality and creativity. The stress, then, in teaching the science prone or for that matter any science student is on creative teaching. What is this creative teaching we are stressing for ? All students have certain similarities ; however, in developing them to their fullest it is the difference in creativeness which matters most. Hence, teaching to stimulate creativeness or originality, is teaching which honours creative differences and which is differentiated in its method. What interpretation of creativity is most helpful in science teaching ? Creativity is a matter of sensing gaps and deficiencies of disturbing elements and forming and testing hypotheses about how these gaps and deficiencies might be bridged.

How often do science teachers give students an opportunity to develop science creativity ? Recognition, identification and formulation of a problem can provide a most important opportunity for students to develop creativity. This ability can be developed if we teach pupils to identify and state problems arising out of science situations. In class discussions, as well as in laboratory, students should be encouraged to propose hypotheses, design experiments to test these hypotheses, and finally evaluate their findings. A flexible teacher who is free to create and learner who is encouraged to think and try out without being threatened, are a mandatory if creativity is to flourish. A starting point might be for teacher to examine his own orientation. Is he secured to depart from traditional methods and conclusions ? Does he teach children or subject matter ? Does he seek new methods of presentation ? Is he enthusiastic about his pupils and his speciality ? Can he ragard his shortcomings with humour? Is he concerned about his personal and professional self ? What kind of persons he would like to be instrumental in forming diligent, obedient, conforming, divergent.

How often are such learning activities provided in science classes which lead to creativity ? Science students including science prone, should be encouraged to ask as many questions as possible to ascertain what and when certain types of questions can lead to creativity. Thought-provoking questions raised by pupils, if channeled properly, can lead to creativity, divergent thinking and productive laboratory activity. Such questions by pupils and their suggestions for solutions to the problems will give the teacher an idea of future creative scientist. In assessing pupils creative thinking in science, overt behaviours need to be observed in the laboratory and in and out of the classroom ; attitudes need to be studied as they are expressed in given situation ; the ability to overthrow a preconceived idea on the basis of new evidence should be noted when and if it occurs.

Is there any best method of teaching science for developing science creativity ? No one particular method is best for all students or for all teachers. In teaching science, an inspirational teacher usually makes use of several methods such as discussion, problem solving, demonstration for enquiry, open-end laboratory experiments, research projects, deductive and inductive thinking and field trips to develop various objectives-cognitive, affective and psychomotor. The artistry of teaching science is dependent on how skillfully the teacher blends several of the methods into a unified teaching lesson so that he in-

duces, motivates, inspires or forces his students to do Science in such a way that they capitalise and challenge their creative potential. This creativity in science also occurs when students make a scientific discovery for themselves even though such information is already known to them. Basic principles will no doubt appear in the textbook, but the specific application or innovation needs to be determined by the students.

Personality Characteristics

In general, science prone students tend to be more quiet, more reflective and more inward-looking. They are more flexible and adaptive in permissive atmosphere. They tend to have a rich flow of ideas ; good memories and associational ability ; divergent and inventive thinking and a high intellectual curiosity, off-the-beaten track. They undertake research projects; utilise leisure time for science hobbies and scientific literature and participate in science activities and other contests They do more, read more and learn more and are most committed to science. In short, they not only go deeper but often have an unusual interest in science which gives them direction. If handled properly and provided with special opportunities these prospective scientists generally become great investigators and specialists. How do they differ from bright and gifted students ?

1. Both bright and gifted students have high genetic factors.

2. Bright students do not necessarily have high predisposing factors ; their goals may not sufficiently be determined, their attitudes not sufficiently focussed ; they may be conforming, easily satisfied.

3. Gifted students have a high predisposing factor in some area, they are committed to that area.

4. If that area is science, they are science prone

The major difference between the bright and the science prone students is the tendency for the bright to reproduce already established conclusions. The science prone student on the other hand has a drive to go beyond. He is particularly responsive to an atmosphere in which he is free to question, test the limits of authority, experiment and adventure. Some science prone students adjust poorly to others. Their ecentricity alienates others and they claim not to care but these are execeptions. Typically, science proneness is accompanied by optimum growth in social interaction. Their irritating traits can constitute a move towards building a creative. climate in science class. Classrooms in which there is safety and freedom, acceptance and applause and encouragement and insistence are frequently the classes of science prone students. Classes which are a authoritarian and in which divergence is limited are more often the source of conforming and striving bright students. What applies to a science class climate, the same applies to the homes of science prone students.

Conclusion

It is a gross mistake to believe that the science prone student can study on his own and that class time should be devoted primarily on the normal students. Truly science prone students are precious and rare and of high potential value to the nation. They must be held to high standards of expectation and performance and helped in developing the inner control and responsibilities that will bring their potential ability into productive ability. For the science prone, materials are to be uncovered, not covered because these pupils need to be encouraged and guided much more than they need to be taught. Their

high educational irritability make them sensitive to learning.

What is the role of the science teacher in the stimulation of students with high ability in science? Each science teacher must seek answer to this question within himself. In every school there are certain students who may become creative scientists. Whether they will or not depends in part on science teachers. These students should be given an opportunity to develop their abilities at the earliest possible time. One need not wait for the ideal time and place for these opportunities are within the existing structure, including the current curriculum If, indeed, the boys and girls of this country are the national resources upon which we draw to meet the shortage of scientific manpower, then those who teach them remain the key to the solution of this problem. We need desperdtely indeed-the teachers who have the training and maturity to develop the future scientists of the country.

A Useful Result of Combination

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The symbol $C(n,r)$ is defined for all positive integer values of n and r provided $n \geqslant r$. In the following article, it is proposed to obtain an expression for $C(n, r)$ in terms of $c(n-k, r-1)$, $k=1, 2, 3\ldots, n-r+1$. For $k=n-r+2, n-r+3\ldots$, $C(n-k, r-1)$ has no meaning as $n-k$ becomes less than $r-1$.

Consider the n quantities a_i, $i=1, 2, 3,\ldots, n$.

The number of combinations taken r at a time which contain a_1 is clearly $C(n-1, r-1)$, since leaving a_1, we have to form combinations of $n-1$ quantities taken $r-1$ at a time. The remaining combinations will not contain a_1.

The number of combinations which contain a_2 (but not a_1) is $C(n-2, r-1)$, since leaving a_2, we have $r-1$ quantities to be taken out of remaining $n-2$ The other combinations will not contain a_1, a_2.

The number of combinations which contain a_3 (but not a_1, a_2) is $C(n-3, r-1)$. Continuing like this, we get the following.

Total number of combinations-Combinations which contain a_1 + combinations which contain a_2 (but not a_1)+ combinations which contain a_3 (but not a_1, a_2) +...+ combinations which contain a_{n-r+1} (but not $a_1, a_2,\ldots, a_{n-r}$). Having a stop here, as the first $n-r+1$ quantities $a_1, a_2, \ldots\ldots, a_{n-r+1}$ being exhausted, we are left with $n-(n-r+1)=r-1$ quantities, from which no combination of r quantities can be formed

Thus we have

$$\begin{aligned} C(n, r) &= C(n-1, r-1)+C(n-2, r-1)+ \\ &\quad C(n-3, r-1)+\ldots, +\ldots, \\ &\quad +C(n-n-r+1, r-1). \\ &= \sum_{k=1}^{n-r+1} C(n-k, r-1) \ldots\ldots\ldots \quad (1) \end{aligned}$$

Replacing $C(n, r)$ by $P(n,r)/r!$, we get,

$$P(n, r)/r! = \sum_{k=1}^{n-r+1} P(n-k, r-1)/(r-1)!$$

$$\text{or } P(n, r) = r \sum_{k=1}^{n-r+1} P(n-k, r-1) \ldots\ldots \quad (2)$$

However, this result can also be obtained directly as in (1)

$\therefore$ (1) & (2) are same as one implies the other.

Applications

To prove that

I. $C(n,r)+C(n, r-1) = C(n+1, r)$

We have,

$$\begin{aligned} \text{L.H.S.} &= C(n, r)+C(n, r-1) \\ &= C(n, r-1)+C(n-1, r-1)+ \\ &\quad C(n-2, r-1)+\ldots+C(r-1, r-1) \end{aligned}$$

(By substituting for $C(n,r)$ from(1))

$$= \sum_{k=1}^{n-r+2} C(n-k+1, r-1)$$

$= C(n+1, r)$......... (by changing n to $n+1$ in (1))
$=$ R.H.S.

II. To prove that $1+2+3$ .... $+n = n(n+1)/2$

Putting $r=2$ in (2) and changing n to $n+1$, we have,

$$P(n+1, 2) = 2 \sum_{k=1}^{n} P(n-k+1, 1)$$

$$\text{or } n(n+1) = 2 \sum_{k=1}^{n} (n-k+1) \ldots \therefore P(n,1) = n)$$

or $n(n+1)/2 = n+ (n-1) + \ldots \therefore +3+2+1.$ which gives the required result.

Similarly by putting $r=3, 4, \ldots\ldots\ldots$, we obtain the well known formulae for the sum of squares, cubes etc. of first n natural numbers.

III. To prove that $1.2+2.3+3.4+ \ldots\ldots + n(n+1) = n(n+1)\ (n+2)/3$

In solving this problem, we have either to use induction or the formula for the sum of squares of natural numbers. However, from (2) by putting $r=3$ and changing n to $n+2$, we have,

$$P(n+2, 3) = \sum_{k=1}^{n} P(n-k+2, 2)$$

$$\text{or } (n+2)\ (n+1)\ n/3 = \sum_{K=1}^{n} (n-k+2)\ (n-k+1)$$

or $n(n+1)+(n-1)n + \ldots\ldots +3.4+2.3+1.2$
$$= \frac{n(n+1)\ (n+2)}{3}$$

Similarly by putting $r=4, 5 \ldots,$ the sums of $1\,2\,3 + 2.3\,4 + \ldots, 1.2.3.4 + 2\,3\,4.5 + \ldots,$ etc. will be obtained.

Science Scrable Puzzle

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Hidden in this alphabet block are the names of 43 scientists. They may be spelled forwards, backwards, up, down or in any direction on a diagonal. To find the ones you missed consult the full list in the key given.

Key to Puzzle

Abelson	Compton
Nelson	Day
Szilard	
Wilson	Lang
Yukawa	Ramsay
Fermi	
Geiger	Chadwich
Werner	Davy
Noyes	
Bell	Bragg
	Aston
Kossel	Humphrey
Nicholson	Einstein
Oppenheimer	Hahn
Fajans	Goldschmidt
Dalton	Dirac
Born	Bohr
	Hertz
Urey	Babor
Willard	
Seaborg	Lawrence
Ghiorso	Soddy
	Pauli
Joliat	Lewis
Cavendish	Lowry

SCIENCE SCRABLE PUZZLE

A	B	E	L	S	O	N	E	L	S	O	N	A	B	D
S	R	I	B	E	L	L	A	N	O	T	P	M	O	C
T	A	N	A	B	A	N	O	Y	E	S	D	S	H	G
O	G	S	B	C	G	E	I	G	E	R	R	X	R	O
N	G	T	O	I	L	O	J	Z	A	O	P	O	E	L
O	W	E	R	N	E	R	Y	L	I	H	B	H	M	D
S	Z	I	L	A	R	D	L	H	K	A	N	U	I	S
L	M	N	E	A	B	I	G	D	E	H	O	M	E	C
O	S	H	S	K	W	I	L	S	O	N	T	P	P	H
H	N	E	S	P	C	R	L	L	O	P	L	H	N	M
C	A	R	O	Q	A	I	E	L	E	D	A	R	E	I
I	J	T	K	M	Y	U	W	N	O	W	D	E	P	D
N	A	Z	S	E	F	V	L	D	C	W	I	Y	P	T
R	F	E	R	M	I	Z	A	I	A	E	R	S	O	P
O	Y	U	K	A	W	A	Z	D	E	H	A	Y	A	D
B	O	P	H	S	I	D	II	E	V	A	C	F	G	H

Science News

Star Sucked Into Black Hole

OHIO State University (OSU) astronomers believe they have seen a black hole eat a star. This is a phenomenon that had been theorized but never observed. The sighting indiciates that astronomers are on the right track in their efforts to decipher the mystery of how galaxies are formed, said OSU astronomer, Mr. Bradley Peterson.

He said that a fellow astronomer, Mr. Gary Ferland and he saw the phenomenon begin about two years ago when they were looking at the galaxy known as NGC 5548 in search of data for another project.

When they looked through a 72 inch telescope in Flagstaff, Arizona, they saw the galaxy's nucleus start to glow more brightly. Through electronic image dissection and spectroscopy, they determined that the glowing brightness was caused by the introduction of new gases and that a star was being sucked into a black hole.

In black holes, matter becomes so highly condensed that their gravitational field is irresistible. The gravitational field even pulls in light, so the black holes can be detected but not seen.

As the star is being taken apart by the black hole, its matter is being compressed so strongly that it emits a kind of light distinguishable from conventional starlight which comes from nuclear reactions, according to the scientist. NGC 5548 is relatively close to the earth. but is still so distant that its light takes about 200 million years to reach the earth. That means the astronomers can use the data in studying how the universe was formed, he felt.

Much of the study of black holes has focused on the extremely bright galaxies known as quasars, where the shredding and compression of matter is apparently occuring with the exceptional concentration. But quasars are so bright that their light makes it difficult to see other objects in the galaxy.

A New Galaxy

ASTRONOMERS believe they have witnessed the birth of a giant galaxy, detecting evidence that perhaps one billion suns had ignited within a huge gas cloud 144 billion trillon km away from the earth. "We are talking about the turn on of an entire galaxy or at least that's what we think" told Mr. Hyron Spinrad, Professor of Astronomy, University of California at Berkelay. The object is too far way for scientists to be positive what it is, but they believe they have found the first evidence for a massive galaxy seen during its formation stages long ago and far away, Professor Spinrad said during the American Astronomical Society's annual meeting, 1986. The possible "proto-galaxy" known as radio wave

source 3C 326.1, was discovered by Professor Spinrad and some others.

The object is 12 billion light years from earth. A light year is the distance light travels in a year. So, the galaxy astronomers think they detected, was actually born 12 billion years ago, quite early in the history of the universe.

Astronomers believe stars form in giant clouds of gas and dust when pockets of material in those clouds collapse inward because of gravity. When it collapses, the gas heats up to the point where it can turn on thermonuclear reaction, creating a star.

Revelation on Comets

RECENT studies have confirmed the widely-held view that comets are ancient relics consisting of pristine material virtually unchanged since the formation of the solar system 5,000 million years ago. This was revealed at a week-long Heidelberg symposium on the exploration of Halley's Comet organized by the European Space Agency.

The symposium, the largest of its kind on comets, also revealed that the nucleus of Halley's Comet was potato-shaped and with a density many times less than that of water. Analysis of the gas and dust in the head of the comet showed that the central nucleus is a large snowball of interstellar dust and grains of ice.

Studies have revealed that the most plentiful elements in the comet are carbon, hydrogen, oxygen and nitrogen, which are present in many complex forms. There is considerable evidence that Halley's Comet is mainly water (80%), with carbon monoxide being the next most abundant compound.

New Instrument for the Blind

AN instrument designed at Moscow's Research Institute of Medical Instrument Making, enables the blind to avoid bumping into a tree, choose clothes of the necessary colour, find a window and determine the level of water in a cup, the operator of the instrument feels objects on his way with an infra-red ray using it as if it were a cane.

It can detect obstacles by the force of the sound signal at a distance of upto six metres. The Soviet instrument, shaped like a pencil box and weighing 300 grams is of universal use. A light photo sensor makes it possible to distinguish between hues and shades of colours and the simple electric device in the form of a miniature water heater will say whether the cup is full of water.

Hepatitis B Vaccine Developed

AN estimated 200 million people the world over who are carriers of the Hepatitis B virus. If hepatitis B do not get the fatal disease, they may develop Cancer of the liver after 10-20 years. A major breakthrough in the area of gastroenterology and liver diseases is the development of a vaccine against hepatitis B. The vaccine has been cleared after trial in the U.S.A. It is being given now to new borns, especially if the mother is a carrier. This was announced at a three-day workshop on continuing medical education organised by the Department of Gastroenterology, G.B. pant Hospital, Delhi.

Dr. Sanjeev Chopra from the Harvard Medical School Boston, Massachusetts, pointed out that the new Hepatitis B Vaccine could, in the years to come, help cut down liver diseases in India, which are very wide-

spread. He pointed out that mothers often transmit the virus to their new born. However, one of the inhibiting factors in the use of the vaccine becoming widespread is that it is very expensive. In the USA it costs $110 for a course of three shots, but immunity from the virus can be for as long as 10 years.

In India a Korean vaccine is now available costing Rs. 205, but it has not yet been used extensively. In the years to come the vaccine would save thousands of lives.

Farewell to Spectacles Likely

LASER surgery now being developed could cure short-sightedness in seconds and do away with the need for spectacles or contact lenses, Professor John Marshall, Head of a U.S. British research team which has developed the method at London University's Institute of Ophthalmology told. The revolutionary operation could be in use within two years.

There are other European centres in France and west Berlin, working with lasers and eyes. But their method is a new and exciting departure which involves resculpting the cornea.

The cornea is the transparent cover to the iris and pupil through which light impulses must travel. Myopia, the medical word for short-sightedness, is the most common of the disorders.

Prof. Marshall and his team backed by funds from a Boston based firm called Summit Technology, call their technique "photofractive keratectomy" (PRK). It involves skimming tiny particles of around 1/1000th million metre thickness of the cornea instead of cutting it. The method has been treated on monkeys with no apparent ill effects or sight deterioration.

People have looked into ways of using the laser as a scalpel, just as a more precise cutting tool for the eye said Prof. Marshall, who has been working for more than three years on the project with Professor Stephen Trokel of the Coloumbian Presbyterian Medical Centre, New York.

But at the moment one skill needs to cut through most of the cornea's thickness, which weakens it. And the patient can still experience vision and healing problems afterwards.

Radial keratectomy (RK), as the cutting technique is called was developed by the Japanese in the 1930s. But the crude technique left hundreds of people blinded until the Soviet Union refined them in the 1960s.

"We are just about at an atomic level of removal and you only need to remove 25/1000 ths of a milimetre to affect sights in a major way. We can reshape it at that level", Prof. Marshall said. "You are only working on the surface on the cornea and it is computer controlled

so it will be easy for opticians to do. It should be reasonbly cheap and enormously lucrative as a commercial proposition".

Prof. Marshall said that research had now reached the stage where more PRK machines, which should cost around £1,00,000 could be installed in university research laboratories.

Dropout Rates Major Problem in Immunization

Some 60 per cent of children in developing countries are now receiving either a first dose of diphtheria, pertussis and tetanus (DPT) or polio vaccines, only 40 per cent are receiving a third dose.

Despite progress over the past decade in protecting against childhood diseases, a WHO report states that immunization..."remains tragically under-utilized", and that the drop-out rates between doses are high.

WHO launched its Expanded Programme on Immunization in 1974 with the aim of protecting all children, by 1990, against these four diseases, plus measles and tuberculosis.

Measles, the cause of the "highest world-wide mortality" among the six diseases, still takes 2.1 million young lives yearly in developing countries, neo-natal tetanus some 840,000 and pertussis another 600,000—a total of 3 5 million deaths from just three killers in addition, polio cripples some 270,000. All figures cited exclude China.

"It may be easier to grasp these numbers if one realizes that for every breath one takes, a child dies from a vaccine-preventable disease," the report points out.

A major problem is the high drop-out rate Children are not taken back to health centres for their second and third doses against DPT and polio. Surveys carried out show a drop out rate averaging 30 per cent for DPT and polio immunizations. And in 13 countries designated "least developed", only 15 per cent received a third DPT dose.

"An acceleration of existing efforts constitutes the over-riding priority," the report states. It recommends :

- That immunizations be administered, "by all curative and preventive health services, even to children suffering from malnutrition or minor illness." The report says that "only a fraction" of health facilities in developing countries provide immunization services.
- That drop-out rates be reduced by "better informing parents of the need to return for further immunization and of the times and places for doing so."
- That immunizations be specifically targeted at the urban poor, a group now generally neglected.
- That renewed impetus be given to immunization against polio, neo-natal tetanus and particularly, measles, as part of primary health care services

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Threat to Health From Drugs Termed 'Narco-Terrorism'

New forms and new combinations of drugs along with new groups of users are leading to growing health and social problem in "more and more countries in all regions of the world." The misuse and abuse of both nar-

cotics and psychotropic substances, added to increased trafficking in them, is tantamount to "narco-terrorism" against a nation's health, reports presented to the recent World Health Assembly show.

The reports urge combating this threat through programmes in prevention and treatment, rather than on drug enforcement solely, which is now generally the case in many countries. In particular, there is a need to aim information and education programmes at youth to counter their "special vulnerability."

The reports say drug use has spread from the students of the 1960s, who were mostly affluent, to persons in virtually all walks of life today, including the disadvantaged. In developed countries, there has been a spread from use exclusively by males to use by females.

"Earlier, a disproportionately high ratio of young males misused drugs," the reports note. "The sex differences have almost vanished so that consumption and abuse rates in males and females are almost equal."

The age of first use of drugs is lower now, with those between 8 and 14 sniffing volatile solvents such as glue and benzine. Multiple drug use is also on the rise. As well, new "designer" drugs—made by altering the chemical structure of existing drugs, and thus largely unregulated by laws—are entering the market. And, partly because more people are living longer, more psychotropic drugs are being prescribed thus making possible more misuse. These are conditions conducive to vast profits and crime.

According to estimates :

- 29 million use cannabis, worldwide.
- 1.76 million use opium, mainly in countries of South-East Asia and the Western Pacific.
- 750,000 use heroin, worldwide.
- 1.6 million chew coca leaf, mainly in Latin America.
- 4.8 million use cocaine, more and more in the industrialised world.
- 2.3 million use amphetamines, and
- 3.4 million use barbiturates, sedatives and tranquillisers, worldwide. □

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SCHOOL SCIENCE

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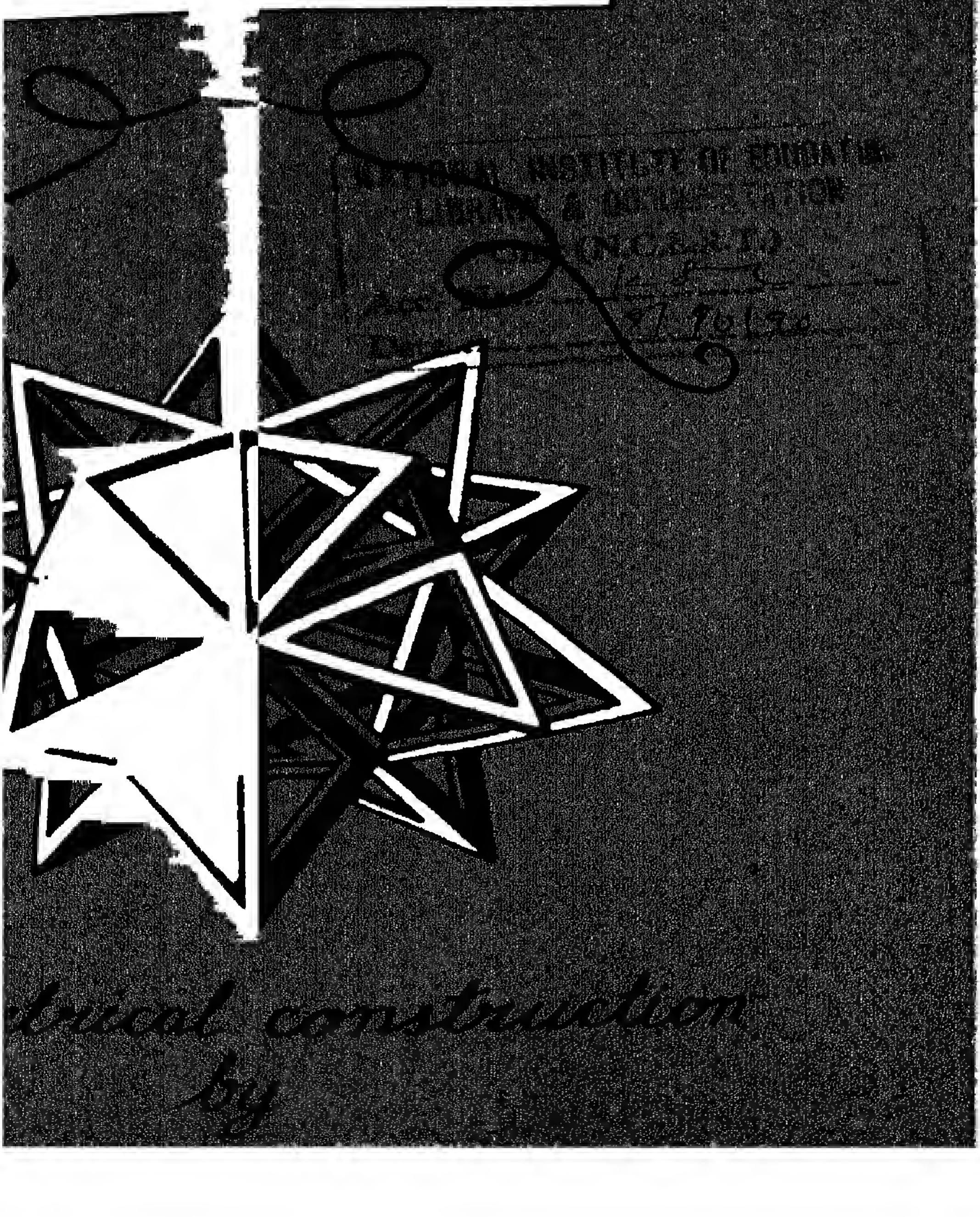

SCHOOL SCIENCE is a quarterly journal published by the National Council of Educational Research and Training. Intended to serve teachers and students in schools with the recent developments in science and science methodology, the journal aims to serve as a forum for the exchange of experience in science education and science projects. Articles covering these aims and objectives are invited. Manuscripts, including legends for illustrations, charts, graphs, etc. should be neatly typed double-spaced on uniformly-sized paper, and sent to the Editor, SCHOOL SCIENCE, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110016 Each article may not normally exceed ten typed pages.

The articles sent for publication should be exclusive to this journal

Illustrations may be limited to the minimum considered necessary, and should be made with pen and indelible Indian ink. Photographs should be on glossy paper, at least of postcard size, and should be sent properly packed so as to avoid damage in transit.

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TO OUR CONTRIBUTORS

SCHOOL SCIENCE invites articles from teachers, acquainting students with the recent developments in science and science methodology. The articles should be addressed to Executive Editor, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110016.

Objectives in Science : Processes versus Products

MARLOW EDIGER

Northeast Missouri State University, Kirksville 63501 U.S.A.

Diverse processes are needed in identifying problems. gathering data or information, developing hypotheses, as well as in testing and revising hypotheses. Varied learning activities also need to be implemented. Variety in experiences is needed to provide for individual differences, as well as to acquire information from diverse resources. Concrete (actual objects, realia, excursions, and experimentation), semiconcrete (films, fimstrips, slides, pictures, transparencies, and other visuals), as well as abstract learnings (listening, speaking, reading, and writing) need adequate emphasis in the science curriculum. Learning activities need to be utilized to guide pupils to achieve process objectives.

Which types of objectives should teachers emphasize ? Should process or product goals be stressed in ongoing units of study ? Or, might rational balance in the science curriculum emphasize both types of ends ?

Process Objectives

Numerous science educators advocate process goals in teaching and learning situations. The American Association for the Advancement of Science (AAAS)[1] in Science : A Process Approach (SAPA) emphasizes learners acquiring the following processes :

1. Observing
2. Recognizing and using number relations
3. Measuring
4. Recognizing and using space-time relations
5. Classifying
6. Communicating
7. Inferring
8. Predicting
9. Defining operationally
10. Formulating hypotheses
11. Interpreting data
12. Controlling variables
13. Experimenting

The above named process ends may be achieved utilizing a variety of learning activities available in many schools today. Thus materials and activities such as the following might be utilized :

1. Experiments
2. Demonstrations
3. Lectures
4. Explanations

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1. Gene Shepherd and William B. Ragan, *Modern Elementary Curriculum*, Sixth edition. New York · Holt, Rinehart and Winston, 1982, page 336.

5. Films, filmstrips, and slides
6. Pictures and transparencies
7. Excursions
8. Models and Realia
9. Discussions
10. Panel Presentations
11. Buzz groups
12. Problem solving
13. Inductive methods
14. Deductive experiences
15. Textbook(s)
16. Encyclopedias (general and science reference sources)
17. Library books
18. Seminars
19. Recitations
20. Debates

An additional set of process goals in the teaching of science are the following :

1. Growth in scientific knowledge means that we are confronted with the necessity of making decisions that have more and more social, economic, political, legal, ethical, and moral implications.
2. Our social systems and the devices by which we make decisions must be mobilized to work more rapidly. That may be made possible if more people come to understand the relationship between science and society.
3. In choosing curriculums, we are trying to determine how to educate people for a future whose characteristics we can only barely guess.
4. Most decisions set off a chain of concomitant changes. The problem in decision making is to reason forward in time to the likely consequences. Each alternative has to be evaluated for its possible effects.
5. The relation between knowledge and its application is not well understood.
6. Science curricula seem to be organized according to one or more of the following points of emphasis :

   (a) Emphasis on process of intellectual skills
   (b) Emphasis on discovery
   (c) Emphasis on problem solving
   (d) Thematic emphasis, or emphasis on content.
7. Although modern elementary science programmes differ in organization, they have many properties in common.
   (a) Students encounter phenomena directly.
   (b) There is time and opportunity to investigate.
   (b) There is room to make mistakes and retrace steps.
   (d) Covering content is not quite so important as the process of interaction between students and materials.
   (e) Quantitative concepts are introduced; measurement and prediction are stressed.
8. All the programmes, properly taught, should make a contribution to the development of language, logic, fate control, and hope.[2]

Why are *process* goals emphasized in ongoing units of study in science ? First of all, processes emphasize a *doing* dimension. Pupils are active, not passive beings. Thus, pupils are involved in identifying and solving purposeful problems. To solve problems, a variety of reading and non-reading resources need to be used as data sources. One or more hypotheses must be tested in life-like

2. Mary Budd Rowe, ***Teaching Science As Continuous Inquiry* : *A Basic*.** New York : McGraw Hill Book Company, 1987, page 23.

situations and may be modified or revised if evidence warrants.

Diverse processes are needed in indentifying problems, gathering data or information, developing hypotheses, as well as in testing and revising hypotheses. Varied learning activities also need to be implemented. Variety in experiences is needed to provide for individual differences, as well as to acquire information from diverse resources. Concrete (actual objects, realia, excursions, and experimentation), semi concrete (films, filmstrips, slides, pictures, transparencies, and other visuals), as well as abstract learnings (listening, speaking, reading, and writing) need adequate emphasis in the science curriculum. Learning activities need to be utilized to guide pupils to achieve process objectives.

Additional reasons for learners achieving process goals include the following :

1. Process objective may be utilized regardless of which generalizations, concepts, and facts are emphasized in any science unit of study. Thus, process ends cut across any subject matter emphasized in numerous units in science.

2. The explosion of knowledge in science situations has been with us for decades. Knowledge becomes outdated, as well as accumulates rapidly. However, science processes remain relatively stable to deal with knowledge explosion settings.

3. Process goals intrinsically are relevant in school and in society. Thus, school and society become integrated, not separate entities. In either situation, among other processes, individuals identify and solve problems. That which is useful in society needs adequate emphasis in the science curriculum.

Product Objectives

There are selected educators who believe that products are more significant for learner attainment, as compared to processes. Behaviourism, as a psychology of learning, emphasizes learners attaining relevant, measurable ends. Thus, what is observable and precise in terms of pupil learning needs to be emphasized. Facts, concepts, and generalizations, if achieved by learners, in degrees are measurable. Worthwhile subject matter learnings can be selected which have high utilitarian values. These facts, concepts, and generalizations may well cut across numerous science lessons and units.

To achieve vital subject matter in science, appropriate processes need adequate emphasis. For example, the process of classifying subject matter is important. Unless learners individually develop appropriate categories, a mass amount of subject matter might be acquired and yet consist of isolated ideas. Knowledge that is related is retained more so by the learner compared to that which is isolated. Ideas achieved consist of the classifications of facts, concepts, and generalizations. Any generalization may be substantiated with supporting facts. Inherent in any generalization are related concepts. Thus, products (facts, concepts, and generalizations) are categorized when classifying is utilized as a process goal. The end objective or goal in teaching, however, are the products of learning.

Which criteria need utilization by teachers and supervisors in selecting worthwhile products (subject matter) for pupil achievement ?

1. What is chosen must be meaningful to learners. If subject matter lacks meaning, pupils will, in general, not retain what has been learned.

2. Pupils must perceive purpose in ongoing units. Thus, what is learned by learners is perceived as possessing inherent reasons for achieving.

3. Preferably learning experiences should

capture pupil interest in each lesson and science unit.

4. Individual differences need to receive adequate attention among learners. Thus, slow, average and fast achievers may attain optimally.

5. Balance among understandings, skills, and attitudinal goals should receive adequate attention. Each pupil then needs to achieve vital subject matter, relevant skills, and develop well in the affective dimension.

6. What is deemed worthwhile in science in the societal arena must also receive adequate attention in the science curriculum.

7. A quality science current events programme may well aid in achieving an updated curriculum.

In Conclusion

Which should receive major emphasis in the science curriculum—processes or products ? Process objectives may be utilized in any science lesson or unit. These significant processes may be emphasized in each of the following academic disciplines—biology, botany, zoology, physics, chemistry, astronomy, geology, and physiology. Vital processes possess high utilitarian values.

Product goals may also emphasize the concept of utility in terms of subject matter learnings for pupils. Thus, broad generalizations, supported by viable facts and concepts may be acquired by learners at ever increasing levels of complexity

A synthesis may also be achieved between process and product objectives in that significant processes used by learners produce relevant products.

Science Corner for a Primary School—Some Ideas

PROF. K.J. KHURANA

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New Delhi

A resourceful teacher has no difficulty in arranging demonstrations and pupil activities required to impart essential concepts and skills of science. He knows several ways to collect the low-cost and no-cost materials needed and also to improvise models/devices required for the purpose But there are teachers who find some difficulty in arranging demonstrations and pupil activities in the absence of the essential items required for showing the demonstrations. This is all the more true in the case of teachers who have had no opportunity to be a student of science and have had no formal training to teach science through activities. Experience of the schools that have developed science corner has shown that it is easy to collect some common items with the help of children.

Science and technology have increasingly been becoming a part of our daily life in the urban and rural areas all over the country. The use of modern implements and techniques in the field of agriculture and the introduction of electricity and some other amenities have brought the life in villages closer to science. The present school curriculum in science and the instructional materials based on it rightly reflect, this development. The course of lower and upper primary stage for classes III to V and for VI to VIII respectively consists of two sets of three textbooks for each. The National Education Policy (1986) has emphasised inculcation of scientific temper for which doing science is a must from the Primary classes. Each textbook is accompanied by a Teachers' Guide suggesting practical ideas for demonstration and pupil activities to provide various teaching-learning situations. The NCERT also developed a science kit for the Primary Schools (classes III-V) but the emphasis has been on the use of local resources and the environment.

Children are born scientists and love to explore their environment. A teacher needs to show simple demonstrations (Fig. 1) and arrange interesting activities for creating learning situations for imparting science. If the resources of a school are enough, all children, in smaller groups of 3 to 5, should do activities suggested in the textbooks. Somehow, the position is not so for a majority of schools. This calls for the need of setting up a 'Science Corner' The Science Corner may not need a room—any covered corner will do.

*The NCERT has prepared a Curriculum Guide for helping the teachers taking Environmental Studies with the children of classes I & II. No textbooks are suggested at this stage as the childrens' immediate environment changes from place to place and sometimes even within a district.

Fig. 1 *A well-planned demonstration, using even simple items, can be very effective in creating a teaching-learning situation.*

A resourceful teacher has no difficulty in arranging demonstrations and pupil activities required to impart essential concepts and skills of science. He knows several ways to collect the low-cost and no-cost materials needed and also to improvise models/devices required for the purpose. But there are teachers who find some difficulty in arranging demonstrations and pupil activities in the absence of the essential items required for showing the demonstrations. This is all the more true in the case of teachers who have had no opportunity to be a student of science and have had no formal training to teach science through activities. Experience of the schools that have developed Science Corner has shown that it is easy to collect some common items with the help of children. For this the teacher has to make some plans and identify the right type of children to help him.

Organising the Science Corner

Planning the needs based on the purpose of Science Corner makes the job easier. Initially the teacher has to organise the collection of the required items with the help of children. He/she must make the children feel that :

- it is to be managed by them ;
— it is their own corner ; and
— it would help them learn science better.

The best thing is to elect to a leader from amongst the children and two more to work with him from other classes. This team of three selected leaders would help the teacher in different ways besides collecting the items required. These team of leaders in turn should take the help of their classfellows as and when required.

A sample list of common items needed for various demonstrations and pupil activities is suggested here : Stones and a brick, dry

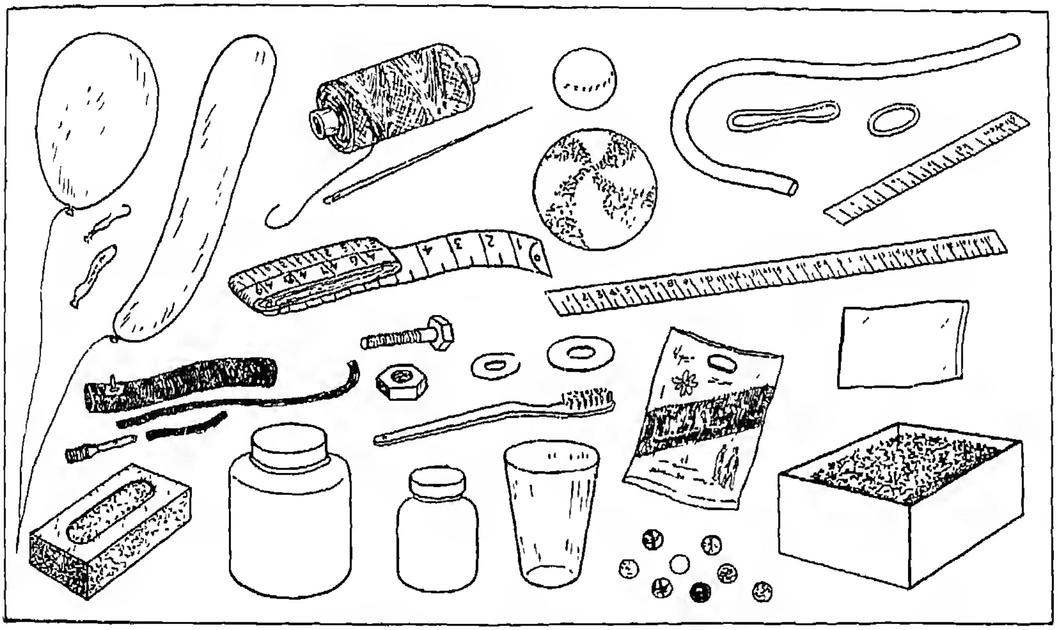

Fig. 2. *Some common items found useful while doing activities in science.*

sand (in a box) assorted rubber-bands, balloons wooden/plastic scale (15 cm and 30 cm), empty cardboards boxes, tailor's tape, thread, string and rope, rubber bands, used bicycle washers, nuts and bolts, empty jars/bottles of plastic or glass, rubber and plastic balls, marbles, plastic tubing, man-made materials (a set of samples).

Odd items like discarded toys, seeds of certain fruits and several other items like used dry cells (not leaking), reeds or used ball-pen refills, drinking straws, caps of milk bottles and of the soft drinks, discarded ice-cream cups are found to be of much avail for the activities (Fig. 3). Such odd items can be collected in a large junk box

Collection of several common items such as seeds, dried leaves of plants, cut shapes, postage stamps (used), and match box covers (empty) provide a good deal of activities in terms of classification. The criterion for classification of such items may be simple for the pupils of lower classes and should gradually grow into scientific classification over the years.

Numerous interesting activities can be done by the teachers and the pupils using simple stationery items (Fig. 4) which are easily available. The common example of an activity most popular with several Primary Schools is making of a *phirki* using a coloured

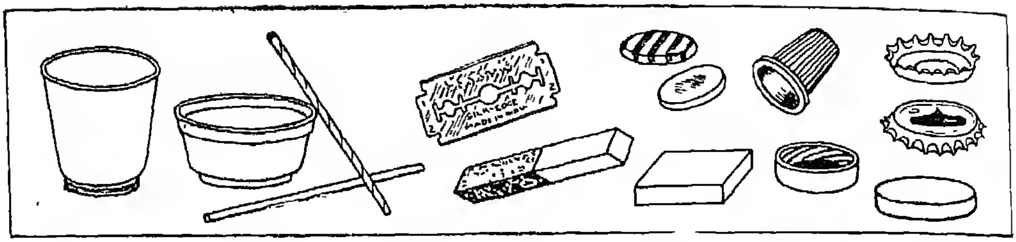

Fig. 3 *A set of some no-and low-cost items often needed for demonstrations and activities in science.*

sheet of paper, an all purpose pin or a thorn and a reed. Another is to use a pair of drawing pins and the bicycle valve tubing or a reed to make a small system capable of rolling.

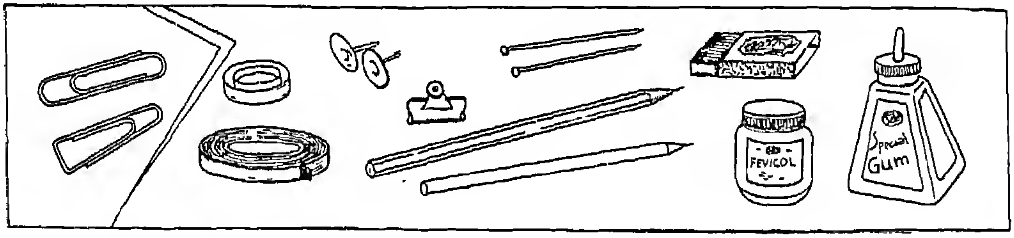

Fig. 4 *Items of stationery found useful for improvising models and for doing activities.*

A number of other items such as a magnet (Fig. 3), a spring balance, a magnetic compass, hand lens, some glass ware (Fig. 5) have to be arranged by the teacher. If the school has funds such items can be purchased for the corner. However, until the time the corner does not procure such items, these may even be borrowed in advance from a nearby secondary school and returned soon after use. What is important at the initial stage is the will to organise the corner and start using the collected items so as to encourage the students in collecting more and more of the items required for the activities to be arranged for the teaching-learning situations while taking science classes.

Making the Corner Functional

A plastic bucket fitted with a tap near the bottom has been put to a profitable use by schools to provide running water for small duration needed for the science activities. It is better to have such a bucket with a tap. Another necessary thing required for a science corner is a source of heat. Although, candles serve the purpose for most of the pupil activities yet a wick-type or pressure-type kerosene oil stove is needed for some demonstrations.

The experience of some teachers in running the science corner has shown that having a set of simple tools like a pair of scissors, hammers (small and a medium size), pliers, screw-drivers (small and medium), a saw or at least a hack-saw blade, help in improvising some simple models and devices

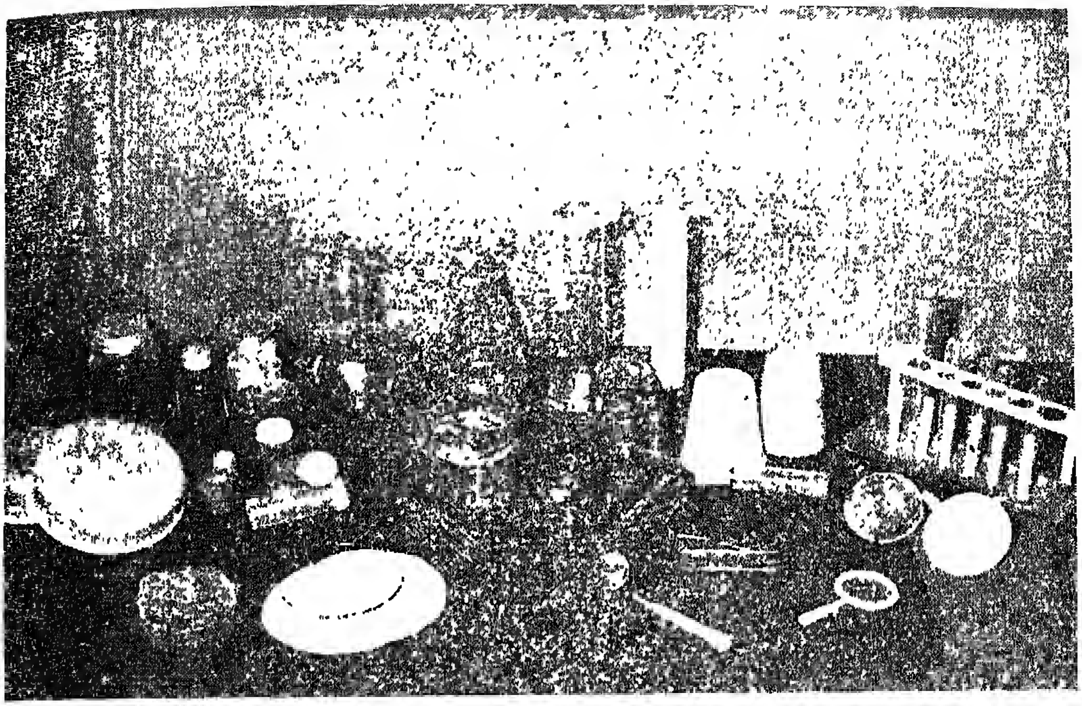

Fig. 5 *Common glass items, plastic tumblers and funnels, aluminium spoons and katoras, find good use in doing several activities. Items like hand-lens and test tubes can't be avoided.*

for making meaningful activities, of course by involving children who enjoy doing such work. Safety of the tools and the users has to be ensured. It is advisable to keep the tools in a locked case and allow their use under supervision and also to keep essential first-aid items handy. It is needless to mention that a collection of materials like cardboard sheets, an aluminium sheet, a plywood sheet, pieces of scrap wood, nails (assorted) and adhesive materials like gum and fevicole would also be required.

Space for the Corner

If a school can afford to provide a corner with shelves in a room, the Science Corner may be set up there. But it is not necessary to have a separate room for it. A covered corner with a table or a raised platform in a verandah will also do. Once the Science Corner starts functioning and making an impact its role is bound to be recognised and all types of help is likely to be available from the school authorities and the community. For the safety of tools and measuring devices a lockable box/almirah may be arranged at some stage.

Various children magazines and newspapers provide interesting material of interest and relevant to the science course for primary classes. A teacher should look for such materials and keep collecting the clippings with the help of the children interested in

this activity. Sometimes posters concerning health and hygiene are available from some Government offices and other agencies. A teacher should not lose such an opportunity. It is worthwhile to fixup a wall space for the display of such materials. The materials need be displayed with the help of children and the theme for display should be changed quite often. A straw-mat or a coloured jute cloth provides an inexpensive decorative background for the display of materials.

Science Corner and the Community

Experts from the community should be invited to address the children and visit the Science Corner in order to guide the children in building it up. Even an ordinary village has a carpenter and other skilled persons who would like to come to the school and help the children, if approached in a proper manner Once such an interaction starts it paves way for the children to visit these experts at the place of their work and observe them in action and learn several things through meaningful interaction on the spot. When activities start taking place it motivates children to show their interest (Fig. 6). Some schools have found having an aquarium and maintaining it in the corner with the help of pupils to be a highly interesting and educative activity. The children, specially in village schools, would love to grow flowering plants, vegetable-beds and useful trees on the pre-

Fig. 6. *Pupil activities like this need motivation and not costly equipment.*

mises of the school, of course depending upon the availability of water and implements besides the encouragement shown by the school authorities and the community.

In a few months enough models, interesting charts, activities and experiments would be made through the Science Corner activities. A school should then arrange Annual Science Fair for one or two days and invite the community. Such a fair would provide confidence to the young children by speaking to the community about their display and would also servet he cause of educating the community, specially in case of rural masses and deprived classes.

The National Education Policy (1986) has emphasised inculcation of scientific temper for which doing science is a must, right from the primary classes.

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The Astronomical Significance of Rahu and Ketu

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Note that the moon covers 360° of the sky in about 27.3 days in its orbit around the earth, or about 13°.18 per day. In fact, one can verify that during a lunar or solar eclipse, the moon actually passes through one of the two points Rahu or Ketu.

Could this be the meaning of the ancient adage that Rahu and Ketu gobble up the sun or the moon during an eclipse? It is easy to say that yesterday's eclipse was caused because Rahu or Ketu devoured the moon or the sun, but it is not possible to predict a future eclipse by this unscientific theory.

Rahu and **Ketu** are not just mythical demons which devour the sun and the moon and are invoked by astrologers. They are well-defined astronomical objects (in fact, points) Their motion plays a very significant role in predicting lunar and solar eclipses.

It is well known to school children that lunar and solar eclipses occur due to the motion of the earth and the moon. Whenever the shadow of the earth falls on the moon, that part of the moon is not visible to us, causing a lunar eclipse. It is clear that this would happen on a full moon day. In the other case, the shadow of the moon falls on the earth, making a part of the sun (or the entire sun) invisible from the earth, and this occurs on a new moon day.

A question arises—Why do solar and lunar eclipses not occur on every new moon and full moon day, respectively ?

This indeed would have been the case if the orbits of the earth around the sun and of the moon around the earth were perfectly circular and in the same plane. To answer the above question, therefore, we must look at the orbits of the earth and the moon a little closer.

The plane of the earth's orbit of revolution around the sun is known as the *ecliptic*. The axes about which the earth revolves around the sun and rotates about itself are not parallel to each other, but are inclined to each other by an angle of 23°27′, or roughly 23°.5. The perspective is explained in Fig. 1. As is well-known, this is the cause of the seasons on the earth. Moreover, the axis of the rotation of the earth around itself *does not* point in a fixed direction ; it rotates in a circle of angular radius 23°.5 about the axis of revolution around the sun once in 25,800 years. This is somewhat like the axis of a rotating top which revolves around the vertical direction.

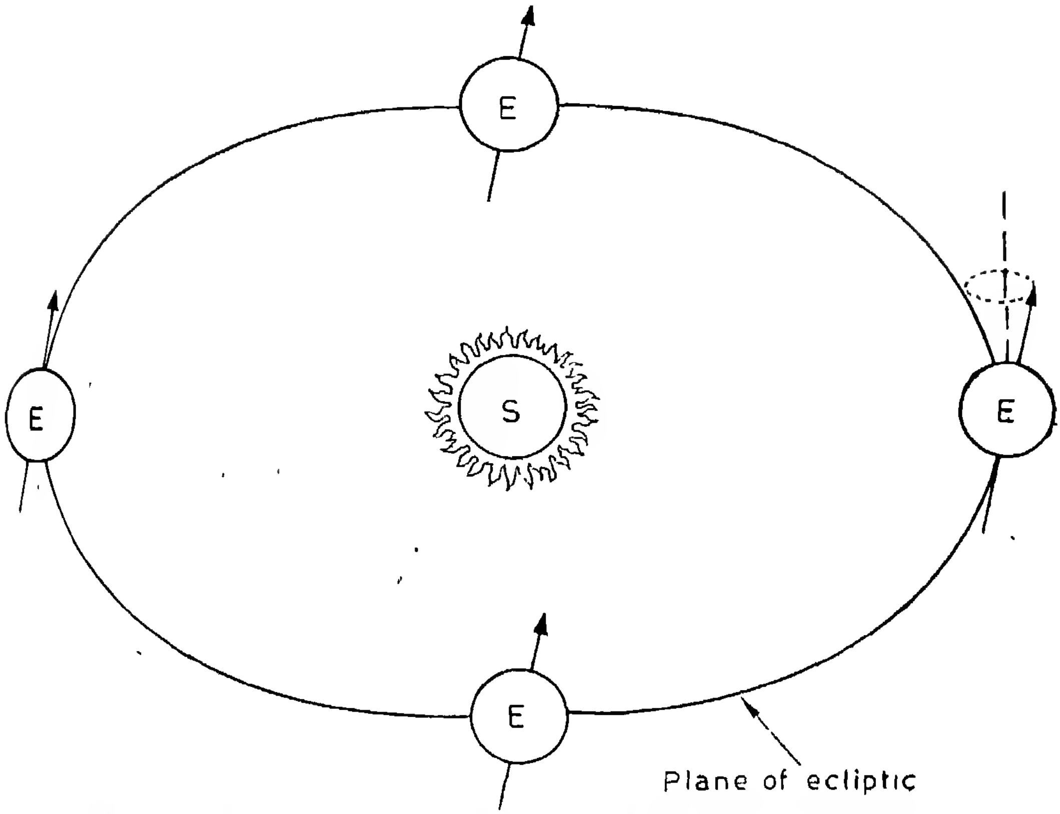

Fig. 1. *The earth's orbit around the sun. The plane of the orbit is known as the plane of the ecliptic.*

Presently the axis of the rotation of the earth points in a direction close to the pole star (*Dhruva tara*). 13,000 years from now, the earth's axis would point in the direction of the star vega, about 47° away from the pole star. This phenomenon is called the ***precession of the earth's axis***, very much like the precession of a top.

The moon revolves around the earth once in 27.32 days (27 d 7 hr 43 min) in an orbit which is inclined to the plane of the ecliptic at a small angle of 5°.14 (5°8′33″). That is, the perpendicular to the moon's orbit makes an angle of 5°.14 with the perpendicular to the plane of the ecliptic ; (see Fig. 2). The moon also rotates about itself once in about the same time, so that we on earth always observe the same face of the moon. This is like a person who goes around a deity (*pradakshina*) ; during the time he goes round the deity, he also completes one rotation about himself, thus facing the deity all the time.

The two points A and D in Fig. 2 where the moon's orbit crosses the plane of the ecliptic are called the ***nodes***. The point A at which the moon comes from below the plane to above the plane of the ecliptic is called the ***ascending node*** (*Rahu*) while the other point is called the ***descending node*** (*Ketu*). Naturally, these points lie exactly in opposite directions as seen from the earth.

Now, the normal ER to the moon's orbit also does not point in a fixed direction, but

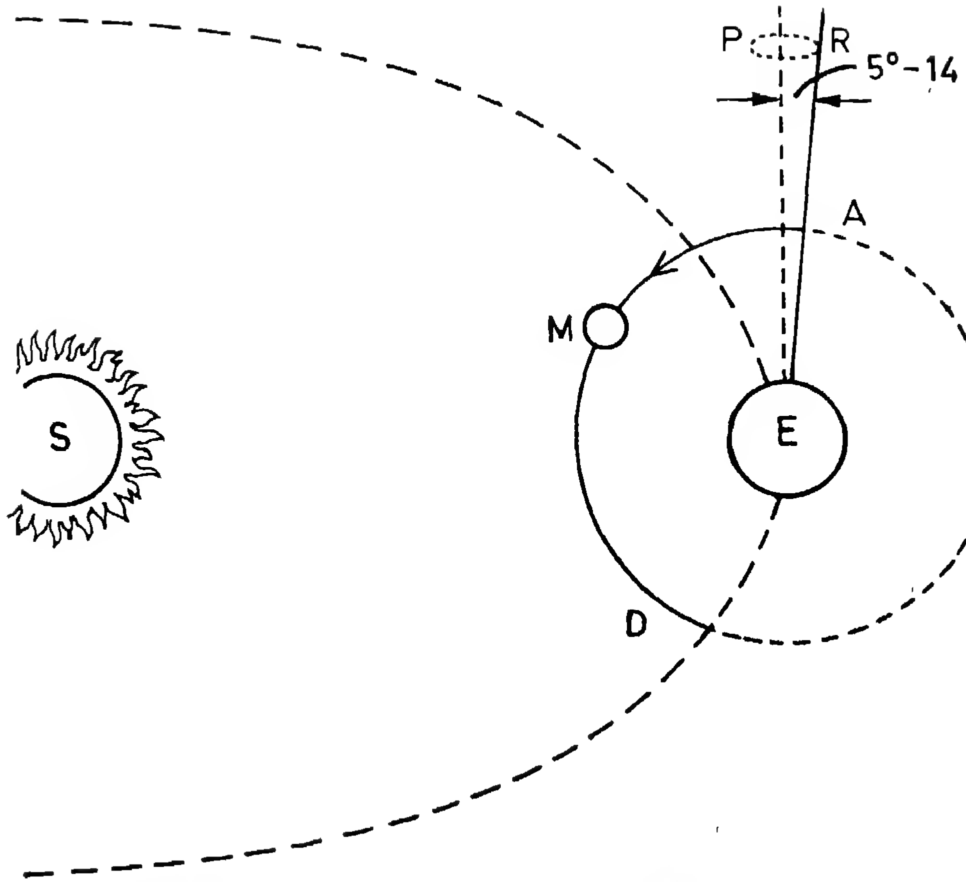

Fig. 2. *The moon's orbit around the earth is inclined to the plane of the ecliptic. The axis ER of this orbit rotates about EP once in 18.6 years.*

rotates about EP with an angular radius of 5°.14 once in about 18.6 years. This is referred to as the ***precession of the moon's orbit***.

To imagine this complex motion, let us take water in a trough and consider the water surface to be the plane of the ecliptic. Imagine that the earth moves around the sun in this plane, with the sun at the centre. Now take a small cardboard disc and fix a nail or a strong straight wire at its centre in a direction perpendicular to the plane of the disc. Holding the nail or wire, dip the disc in water so that its plane makes a small angle of about 5° with the surface of water (or the nail makes an angle of 5° with the vertical), until the disc is half inside the water and half above it. Now one can imagine the earth to be at the centre of the disc (on the water surface or the plane of the ecliptic) and the rim of the disc to be the orbit of the moon. The points of this orbit which just touch the water surface would represent the two nodes—*Rahu* and *Ketu*.

If we now rotate the nail slowly along a circle about the vertical, always keeping its

angle with the vertical equal to about 5°, this would have the effect of *Rahu* and *Ketu* revolving around the earth (while always keeping diametrically opposite to each other). This is the precession of the moon's orbit with a period of 18.6 years as mentioned earlier. One must note that this slow precession of the moon's orbit takes place in combination with the annual revolution of the earth around the sun.

This, in essence, is the motion of the sun-earth-moon system. In addition, the size of the earth relative to the moon and the sun also has an effect of the occurrence of eclipses For example, the shadow (umbra) of the earth due to the sun may cover the entire moon but the shadow (umbra) of the moon can *never* cover the earth entirely. That is why we never observe a total solar eclipse from *all* points on the earth simultaneously.

Having understood these preliminaries, we may now ask the question : When would the moon be exactly in line with the earth and the sun ? This would occur when, during the earth's annual motion around the sun and the precession of the moon's orbit, the points *Rahu* and *Ketu* are also in the same line as the sun, the earth, and the moon. When *Rahu* and *Ketu* are not near the sun-earth-moon line on a new moon or a full moon day, it means that the moon is almost on the sun-earth line but not quite close to it as to cause an eclipse.

Thus we have two conditions for lunar and solar eclipses : (1) It should be a new moon day or a full moon day so that the sun, the moon, and the earth are *approximately* in a straight line ; and (2) *Rahu* or *Ketu* should be within a few degrees from the sun in the sky as seen from the earth (within about 5° for a lunar eclipse and within about 2° for a solar eclipse) for the three celestial bodies to lie *substantially* in a straight line so that the shadow of the earth or the moon may fall on the other.

Note that the moon covers 360° of the sky in about 27.3 days in its orbit around the earth, or about 13°.18 per day. In fact, one can verify that during a lunar or solar eclipse, the moon actually passes through one of the two points *Rahu* or *Ketu*.

Could this be the meaning of the ancient adage that *Rahu* and *Ketu* gobble up the sun or the moon during an eclipse ? It is easy to say that yesterday's eclipse was caused because *Rahu* or *Ketu* devoured the moon or the sun, but it is not possible to predict a future eclipse by this unscientific theory. For this a thorough knowledge of the orbits of the earth and the moon, their inclinations, the precession of these orbits in space, etc., is required. It must be with such knowledge that our predecessors culculated and predicted eclipses with an accuracy which can very well compare with that of the modern calculations.

Evaluation as Feedback and Guide

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Materials and processes of evaluation are to be so developed and utilized that they are integral to and not apart from the learning processes in a course. Assessment, therefore, is continuous and comprehensive and is a step along the path to learning.

The most visible, though not necessarily the most important, part of evaluation is examinations and over emphasis on examinations, grading and marks tends to produce an image of evaluation as a terminal thing. Evaluation, in fact, is a much broader concept and its significant function is the generation of feedback for guiding teaching and learning. It starts when a child enters any formal course of study, continues throughout the duration of course and achievement is certified at the end of the course. These three parts of evaluation are termed as 'Entry assessment', 'Formative assessment' and 'Summative assessment'. The kind of evaluation programme followed in our schools is terminal in nature, i.e., summative assessment. In summative assessment it is presumed that all those who pass the final examination have achieved the defined level of competence. Formative assessment on the other hand is for guidance only and is an integral part of teaching-learning process. Formative assessment serves two important purposes of evaluation Firstly, it provides feedback to both students and teachers, thus helping them to improve their learning and teaching efforts. It helps a student to know to what extent he has succeeded and to what extent he has not yet achieved the mastery. It helps student to know what the gaps are, so that he can figure out what to do about them. Secondly, it helps to evaluate those objectives which cannot be evaluated in one terminal examination. If the goals of Science Education include such objectives as the spirit of inquiry, appreciation, moral commitment to conscientious citizenship, along with the mastery of subject matter, then these must also find place in school's evaluation programme. Unless the school keeps trying to find out how well it is succeeding with a purpose, the purpose itself is likely to atropy. The feedback generated by formative evaluation also helps broader goals of curriculum development and educational policy. Of the three, the formative assessment is most important for any evaluation programme to be functional and successful.

Strategy of Formative Evaluation

The Science Education programmes now

place greater emphasis on scientific enquiry and its relevence to societal needs. The corresponding shift in the evaluation programme requires the assessment of such abilities as scientific attitudes and scientific processes. Materials and processes of evaluation are to be so developed and utilized that they are integral to and not apart from the learning processes in a course. Assessment, therefore, is continuous and comprehensive and is a step along the path to learning. Evaluation is made in relatively similar situations to those of learning and teaching. Evaluation programme is planned while writing the objectives and methods. A wide range of tests and other evaluative devices are included in the evaluation programme, to evaluate different kinds of abilities.

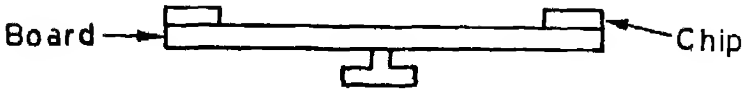
Relating Evaluation to Objectives and Methods

First step in this sequence is the identification of objectives. Objectives are written in terms of specific behaviour that can be observed and evaluated. These have been classified into three domains, namely, Cognitive Domain, Affective Domain and Psychomotor Domain. Cognitive behavioural objectives refer to remembering previously learned knowledge and being able to apply it to solve problems Affective objectives refer to interests, attitudes and values. Psychomotor objectives refer to muscular and manipulative skills. Next step is to determine the content, methods and evaluation material for achieving and assessing the objectives. For the purpose of teaching and evaluation, the three domains i.e. cognitive, affective and psychomotor are taken together as a comprehensive 'whole'. For example, while imparting knowledge on 'Plant Classification and Structure', the values, attitudes and interests related to plant life are also inculcated and evaluated. Students interest here may be evaluated by his own record of observations and collections of various plants. Simple questions such as "Should we allow technology to destroy natural plants 'or' advantages of growing plants in school campus" can help the teacher to evaluate values and attitudes that a student holds towards plant life. Experiment such as "observing anatomical structure through microscope or measuring plant growth over a period of time can be used to evaluate skills such as handling of microscope, perception, etc". In science, activity leads to observations and theory and it is, therefore, taught and evaluated in that spirit. The assessment of various objectives of learning and teaching requires a variety of evaluation techniques, instruments and procedures such as written tests, experiments, projects, checklists, rating scales, interest inventory, attitude inventory, questioning (oral), student record, and teacher record etc.

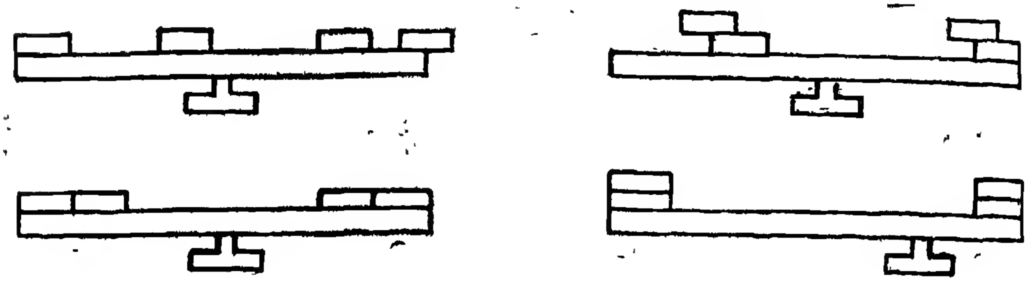
This paper discusses the use of some of these techniques :

Objective	Type of Evaluation
1. The ability to record and interpret temperature data from information gathered using outdoor thermometers.	*Charts* prepared by each child. Check if the chart shows an accurate and readable table of data. Questions such as : Indicate the hottest and coldest day on the graph. On which two days was the tem-

Objective	Type of Evaluation
	perature about the same at noon ?
2. Ability to analyse relationship between load, effort and fulcrum.	*Questions* of the type : When the board above does not tip to one side or another, it is said to be................. (a)



(b) Circle the stick that is balanced :



Objective	Type of Evaluation
	(c) To weigh things on a balance scale, you must balance the empty scale first. (This is true) (This is false) (d) The effort on a machine is 15 pounds, the resistance moved is 75 pounds. How many times was the effort multiplied ? (e) A men weighing 120 pounds climbed a 55 foot ladder. How many foot pounds of work did he do ?
3. Ability to synthesize information on 'Sources of Water Pollution'.	***Essay questions of the type*** The big industries in our town are polluting our water because............
4. Ability to test the hypothesis that dissolution of sugar in water is facilitated by : (a) Stirring (b) Heating &	***Experimentation*** Check observations made by students in control experiment and the conclusions drawn. Questions of the type :

Objective	Type of Evaluation
(c) Crushing Sugar.	(a) Why is control experiment needed ? (b) Verification of hypothesis with salt/water, check and see if results differ. (c) Why are electric mixtures used at the soda fountain to make malted milk ? (d) Why does granulated sugar dissolve faster than lump sugar ?
Ability to handle microscope.	*Rating Scale of the type* (a) Careful in handling microscope. 1 2 3 4 5 (b) Cleans lenses properly. (c) Focuses instrument properly. (d) Prepares slides correctly. (e) Arranges mirror for correct amount of light.
Student's attitude towards science.	*Continuum* of each of two opposing words on a line. Student is asked to show where he is e.g. Science is (a) Theoretical................Practical (b) Objective..................Subjective (c) Universal..................Limited (d) Useful.......................Harmful (e) Exciting ....Boring (f) Easy...........................Troublesome
Student's interest in plant life around him.	*Student record.* Check each student's collection of specimens, diagrams etc. Check if he notes down the characteristic features and classifies them.
Student shows democratice behaviour while working in a group.	*Observation Schedule* (a) The student takes his/her turn Yes No

Objective	Type of Evaluation
	(b) Shares equipment with fellow friends Yes N
	(c) Verifies his/others' observations to clear discrepancies and so on.
9. Value system a student holds for plant life.	*Questions*, e.g., Should we allow technologic progress to continue the destruction of natural plant life ? or 'The land becomes infertile if trees are not grown on it', comment.
10. Ability to design investigation to prove that air exhaled by human beings is CO_2 ?	*Project* Examine experiments suggested by each student. Check if the experiment works in order. Also check the observations made and conclusions drawn, check graphs/diagrams made; equipment used.

One thing is common with all the evaluation tests, whether it is a written test or a rating scale : that it provides feedback to the teacher and student and controls the next step in teaching-learning process. Evaluation interaction is a positive force in teaching-learning process and is a source of self evaluation.

Formative evaluation is continuous and comprehensive and much of it is centred in the teacher. He is constantly using his personal sensitivity in selecting, constructing and using evaluation techniques. The data arising out of this evaluation process determines his next choice of subject matter and method. Evaluation is most effective when it is in terms of what is important to the learner.

Teaching Environmental Education through Games—An Experience

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Experiments with the utilization of 'games' as an instructional component have revealed that through games students can be genuinely motivated to learn through active involvement. Carter and Tyelee (1979) write that "Games challenge children to learn as they compete, as they socialise, as they solve problems or make decisions, and as they have fun". Educational games differ from games purely played for recreational purposes, in that they are always based on an instructional objective and the learning experience provided is always planned and deliberate.

Introduction

Motivating students to actively participate in their classroom learning has been one of the most challenging tasks of a teacher or an instructional planner. Researchers concerned with this task have been making a continuous attempt to comprehend the task in its entirety and arrive at effective instructional techniques or strategies for promoting students participation. Their concerted and sustained efforts have led to identification of various instructional techniques, hypothesising their potentialities and testing their effectiveness. Experiments with the utilization of 'games' as an instructional component have revealed that through games students can be genuinely motivated to learn through active involvement. Carter and Tyelee (1979) write that "Games challenge children to learn as they compete, as they socialise, as they solve problems or make decisions, and as they have fun". Educational games differ from games purely played for recreational purposes, in that they are always based on an instructional objective and the learning experience provided is always planned and deliberate.

Research Findings

There are enough studies in the literature which support the various instructional advantages of games. Heirich, et al (1982) have indicated that games can be effectively used for the attainment of cognitive objectives in general, particularly those involving recognition, descrimination or repetitive drill. Margic Golick in her book "Deal Me In" points out the various ways by which games can contribute to learning motor skills, sense of direction, visual perception, verbal skills, problem-solving and social skills, rhythm, etc. Trollinger (1977) with his work on

games has documented eight research findings :

- — Games teach factual knowledge by rewarding the correct usage of such knowledge during the play of the game.
- — Certain games enhance critical thinking and decision making skills of students.
- — Knowledge retention is enhanced by gaming because of the active participation of the players.
- — During a simulation game the teacher's role is changed from an endower of knowledge to a facilitator and resource of knowledge.
- — Games are often models of real life situations. Thus many students may see the relevance of information for their future lives.
- — Games motivate students because of the active participation in the learning process.
- — Games are multidisciplinary, and require the utilization of many skills found in all of the major disciplines.
- — Games may be adopted to meet the needs of heterogeneous classes.

Types and Formats

Games are of different categories and can be played in different formats.

Diagram-1 represents different types of games and the various instructional objectives for which they could be made use of. As more than one objective could be achieved by using a particular type of game, no attempt has been made in the diagram to correlate them.

DIAGRAM 1 : **Types of Games and Objectives**

Individual	Mazes Crosswords Puzzles Card Games	Motivation Awareness	Knowledge Understanding Application
Small group (>2<5)	Board games Paper-pencil Pictorial activity Material Manipulation Role-playing Simulations Memory games	Concept development Development of affect attributes	Decision making Cooperation Competition Open-mindedness Social skills
Large group (>5)	Field games Mathematical games	Development of skills	Language skills Verbal skills Motor skills, etc.

Of the different types of games indicated in the diagram, role-playing and simulations need to be given a special focus, as they have been found most educationally potent, and since through them students can be introduced to real life situations.

Role-playing, usually, being based on a predetermined scenario has been successfully used for developing in children a sense of identification with the roles and understanding of inter-personal relationships and attitudes and of the effect of values on behaviour.

Simulations have the merit of being sufficiently realistic to represent the reality being studied, and to require from the learner whatever analysis, interpretations, solutions or decisions would have to be found in the real world (UNESCO, 1984).

Choosing or Developing a Game

There are many games available in the market, which could be easily adopted for instructional purposes with slight modifications. Examples of commercially available games are Board games, Scrabble, Mazes, etc. However, many games could be easily developed by the teacher depending upon the content to be taught and the learner characteristics. Field games, compared to board games and mazes, are much easier for a teacher to develop. Examples of games listed in Table 1 are of this type (teacher made) and would be more effective as they are developed by the teacher himself/herself for the achievement of a well defined objective. The different steps involved in the development and utilization of a game are :

(a) defining the content, and the objectives in behavioural terms ; (b) defining the prerequisites ; (c) choosing the appropriate form of interaction (individual, or small group or large group) ; (d) deciding the format or type of the game ; (e) formulating the rules of the game , (f) developing evaluation items, and lastly, trying it with children and effecting necessary modifications.

CEE's Experience

At the Centre for Environment Education (CEE), Ahmedabad, an autonomous body under the Department of Environment, Forests and Wildlife, Government of India, a number of games have been developed to teach Environmental Education (EE) and have been tried out with school children to assess their effectiveness. A few of the games tried out and the objectives achievable through them are represented in Table 1.

TABLE 1 : **A Few Illustrative Games with the Objectives Achievable**

Game	*Concept Involved*	*Objectives Achievable*
Pass the Pebble	Diversity in the characteristics of objects in nature.	Develops the sense of touch.
Body Language	Use of body for developing the mental capabilities of an individual.	Awareness about the flexibility of the body.
Moving Naturally	Movements/locomotion and adaptation in animals.	Awareness of different types of movements exhibited by animals.

		Knowledge about the different movements and the adaptation by animals. Understanding to the movements and the need for adaptation. Develops an appreciation for the way each animal moves. Creativity by way of enabling children to write or enact a poem or a story based on the different types of movements.
Web of Life	Food chain Interdependance and balance in nature.	Awareness of the interdependence of living and non-living things in nature. Knowledge of food chain and the elements that form a food chain. Understanding of direct and indirect linkages of elements in nature Appreciation of the fact that balance in nature gets disturbed due to excessive human intervention. Attitude towards preservation and protection of animals and plants. Calls for divergent thinking when students try to establish relationships among various elements in nature.
Oh Deer !	Basic elements of life. Habitats and their role.	Awareness of the basic necessities of all living organisms. Knowledge of how habitat affects species survival.

	Predators and prey in maintaining animal population.	Understanding of the need for preserving the various habitats. Skills of plotting on graphs and comparing. Arithmetic skills like addition, substraction, etc.
My World	Habitat and its importance.	Awareness of different elements that constitute a habitat. Knowledge of harmful and harmless elements in a particular habitat. Understanding of the Laws of Nature. Respect and appreciation towards the role of individual elements in a habitat.
A Poet in Every Child	Objects in nature.	Develops a feeling of belonging or oneness towards nature. Identification and characterization of a chosen natural object. Helps develop use of English grammar.

(Details of the games cited above and a few more can be obtained by writing to the authors)

Children who experienced these games, expressed that :

- it is interesting to learn through games as it involves fun and physical movement,
- we understand ideas like Food chain, Interrelationships and interdependence in Nature better through games like Web-of-life, Oh Deer !, etc., compared to regular classroom teaching,
- some of the games we can play outside the school hours too,
- learning through games requires much less effort on our part,
- we would like to play more games and learn more.

The games have also been tried out with teachers during teacher training programmes of the Centre. In the year 1986, CEE organised 46 one-day teacher training workshops throughout the country as a part of National Environmental Awareness Campaign. Nearly, 6000 teachers were exposed to various techniques and approaches to teaching EE. Teaching through games was one of the important techniques exposed to teachers.

The overall reactions of the teachers towards using games as an instructional component were positive. Teachers expressed that :

— organising educational games requires active involvement of teachers and

students, and it is interesting to teach through games,

children enjoy learning through games, as it provides enough fun, amusement, and opportunities to participate actively,

well designed games make concepts simpler for the children to understand,

utilising games in teaching helps a teacher to break the monotony of the classroom, and games help children to retain the information for a longer duration.

However, there were also a few practical oblems raised by teachers regarding the nduct of games. A few significant ones ve been :

the bigger the class strength, the more difficult for the teachers to handle the students as students tend to become more boisterous,

the tendency of the students to play an educational game like any other recreational game makes it necessary to play the game more than once,

the duration of the regular class period (30-35 minutes) is sometimes inadequate,

non-availability of adequate game material or lack of training in the development and use of games.

From the above reactions it can be concluded that games could be an effective technique to make the learning interesting to children.

Needed Effort

Despite all the instructional pay offs of Educational Games, they are yet to make an impact on the Indian Educational Scene. It would be worth if more thought is given to popularizing this component in our school instruction and encouraging teachers, specially at the primary and upper primary levels to use them as a regular instructional component. Research wings of the Central and State Institutes of Education should develop educational games related to various concepts included in the school curriculum and supply them to schools. Besides, these institutions should also train teachers in the preparation and utilization of games through workshops, short training courses, etc.

As Bertrand Russel has put it "Love of play is the most obvious distinguishing mark of young animals, whether human or otherwise". If adequately exploited, games could act as an invaluable instructional tool in the hands of teachers who have been struggling to make the process of learning interesting to children and enabling them to participate in the process actively.

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Identification of Scientifically Creative Youngsters—Issues and Implications

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Creativity has been interpreted differently by different researchers. It is a complex concept encampassing a wide spectrum of activities. Now by putting prefix "Scientific" to on already complex concept, a new dimension is added to it. Hence, the problem arises : what is meant by 'scientific creativity'? Has scientific creativity some specialities of its own which are different from other types of creativity ? This problem can be best attacked by looking into the very nature of science and to choose what special factors or components characterize the scientific creativity.

Among all the national resources, the creative potential of its human resources play the motive force for the exploitation of other resources. If this potential is utilised properly, other resources get exploited easily and quickly. Thus, the consequent need for ever wider use of human ingenuity is being felt very much by every nation. But unless its identification and proper development is ensured, the very expectation of its maximum utilisation will prove deceptive and imaginary. As such, the research on identification of creativity especially 'scientific creativity', has been drawing more and more attention in this age of science and technology. Now the problem that arises is : Can we identify the scientifically creative youngesters ?

What is Creativity ?

The usual method for estimating the intellectual potential of a person is the calculation of his I.Q. But the notion that the traditional kinds of intelligence tests measure all that is worth-knowing about a person's intellectual functioning has been challanged by many researchers. It has been pointed out that the kinds of intelligence-tests commonly in use these days concentrate on convergent thinking and ignore divergent thinking which is considered to be of great importance for creativity. Thus, there is an increasing realisation of the shortcomings of intelligence-tests in the sense that they sample only a narrow band of the total range of intellectual abilities. Hence, the need for a special kind of tool capable of measuring the most important aspect of intellect called 'creativity' is now being felt much. Such a tool must encampass the aspects of divergent thinking. According to Guilford (1956), "Divergent thinking is a kind of mental operation in which thinking proceeds in different directions, sometimes searching, sometimes seeking variety and is opposite

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Effectiveness of Concept Attainment and Biological Science Inquiry Models of Teaching on Pupils Achievement in Biological Science

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The study envisages the before and after treatment measurement of the pupils' achievement in biological science. To achieve this objective, pre-test, post-test control group design was proposed. For this purpose, three sections of Class VIII students equal in intelligence and socio-economic status were formed.

Imparting knowledge in its various forms is still considered to be the primary objective of schools. A great need is felt to develop students who can learn and think for themselves. The knowledge explosion and change oriented society of today requires an ability to gather and assimilate information. It has become essential to increase the information processing capabilities of students. Joyce and Weil (1985) have empirically tried out the efficacy of different models of teaching and claimed that these models can take into *account the educational goals and curriculum* together with the psychology and the need of the child. These models can also equip the teachers with alternate teaching strategies in order to suit different types of goals at different levels.

Concept attainment model developed by Bruner and his associates (Joyce & Weil : 1985) focuses to develop the thinking capabilities of students. Biological Science Inquiry model of J. Schwab (Joyce & Weil : 1985) also tries to develop thinking through research processes. Both these models are from Information Processing family. These models have been found effective in American conditions (Lucas : 1971, Abdullah : 1981, and Fullerton : 1964). Here the effectiveness is tried in Indian situation.

METHOD

Design

The study envisages the before and after treatment measurement of the pupils' achievement in biological science. To achieve this objective, pre-test, post-test control group design was proposed. For this purpose, three sections of Class VIII students equal in intelligence and socio-economic status were formed. These three groups were :

1. Experimental group I (E_1)
2. Experimental group II (E_2)
3. Control group (C)

Sample

Purposive sampling was done for the present study. Total sample consisted of 78 students of class VIII from a selected girls' school of Varanasi city. Each group consisted of 26 students.

Tools

The following tools were used for the present study :

(a) Samanya Mansik Yogyata Parikshan by Joshi (1956)

(b) Socio-economic Status Index Scale by Varma and Saxena (1976)

(c) Uplabdhi Pariksshan, for the measurement of pupils achievement in biological science prepared by the researcher.

Procedure

Present investigation was an experimental type of study which was undertaken to study the effect of Concept Attainment model and Biological Science Inquiry model for teaching biology to VIII class. The academic achievement was the main criterion for finding out the effectiveness of different teaching techniques. All the three groups were matched on the basis of the intelligence and socio-economic status index scores. Concept attainment model was chosen for one experimental group and biological science inquiry model for the other group. Traditional teaching strategy followed the control group for 36 periods of 40 minutes duration. Each group was taught through its respective teaching strategy. Teacher variable was also controlled as the same teacher taught through all the strategies. Before teaching each group was pre-tested for their achievement in the selected subject.

FINDINGS

Findings of the present study has been preceded by its corresponding objective and hypothesis.

Objective I —To study the effect of Concept Attainment model based teaching on pupils achievement.

Hypothesis I —To achieve the above objective null hypothesis formulated was—

"There is no significant difference in the pre-test and post-test achievement scores of pupils when taught through Concept Attainment model of teaching".

To test this hypotesis 't' test of significance of mean difference was applied and 't' value along with its means and SDs of two trials have been given in table-1. Value of 't'—13 21 is significant at 0.01 level. This shows that there is significant gain in the achievement when taught through Concept Attainment model. Post-test mean 30.23 is greater than the mean of pre-test scores 12.62. This indicates that the achievement due to the model is not by chance.

TABLE 1

Table for Showing Pupils' Achievement When Taught Through Concept Attainment Model

Treatment	*N*	*Mean*	*SD*	*'t' Value*
Concept Attainment Model Pre-test	26	12.62	5.78	13.21**
Concept Attainment Model Post-test	26	30.23	9.09	

**Significant at 0.01 level

Objective II —To study the effect of Biological Science Inquiry model based teaching on pupils achievement.

Hypothesis II—"There is no significant difference in the pre-test and post-test achievement scores of pupils when taught through Biological Science Inquiry model of teaching".

Again 't' test of significance was applied to test the hypothesis and 't' value, for means of the two groups and their SDs are tabulated in table-2. Value of 't' found (11.90) is significant at 0.01 level and shows that the second trial (post-test) is significantly different from the pre-test. The difference in the post-test mean (26.58) and pre-test mean (16.73) is only due to the effect of the model.

TABLE 2

Table for Pupils' Achievement When Taught Through Biological Science Inquiry Model

Treatment	*N*	*Mean*	*SD*	*'t' Value*
Biological Science Inquiry Model Pre-test	26	16.69	3.69	11.90**
Biological Science Inquiry Model Post-test	26	26.58	5.31	

**Significant at 0.01 level

Objective III—To compare the effectiveness of Concept Attainment model and Biological Science Inquiry model based teaching on pupil achievement.

Hypothesis III—"There is no significant difference between the gain achievement scores of pupils taught through Concept Attainment model, Biological Science Inquiry model and Conventional teaching".

The hypothesis was tested by applying 'F' test of significance of difference among the means of gain scores of achievement when taught through Concept Attainment model,

Biological Science Inquiry model and Conventional teaching and the result found is given in table-3. 'F' value 8.86 is significant at 0.01 level. This clearly shows that these three different approaches are different from each other and the effect due to the teaching through different approaches are also different For finding out the relative merit of these approaches 't' test of significance of difference among the means for pair of groups have been applied and it is tabulated in table-4.

From the table-4 it is clear that Concept Attainment model is more effective than the Biological Science Inquiry model. Value of 't'—2.39 is significant at 0.05 level, whereas Concept Attainment model is significantly different from Conventional teaching as the 't' value 4.20 is significant at 0.01 level. The mean of group taught through Concept Attainment model (18 08) is higher than the mean of the group taught through Conventional teaching (10.45). Biological Science Inquiry model is also more effective than the Con-

TABLE 3

Summary Table for ANOVA Among Means of Gain Scores is Achievement of Pupils in Biological Science When Taught Through Concept Attainment, Biological Science Inquiry Models and Conventional Teaching

Source of Variance	*df*	*Sum of Square*	*SS (Mean)*	*'t' Value*
Among Mean Square	2	742 44	371.22	8.86**
Within Mean Square	75	3141.71	41.89	

**Significant at 0.01 level

TABLE 4

Summary Table Showing Mean, SDs and 't' Value for Two Treatments Taken Together at a Time

Treatment	*N*	*Mean*	*SD*	*'t' Value*
Concept Attainment Model	26	18.08	7.10	2.39*
Biological Science Inquiry Model	26	13.85	6.35	
Concept Attainment Model	26	18.08	7.10	4.20**
Conventional Teaching	26	10.45	5.77	
Biological Science Inquiry Model	26	13.85	6.35	2.02*
Conventional Teaching	26	10 45	5.77	

*Significant at 0.05 level
**Significant at 0.01 level

ventional teaching (significant at 0 05 level) Mean of group taught through Biological Science Inquiry model (13.85) is greater than the mean of group taught through Conventionalteaching (10.45).

DISCUSSION

Brunner's model of Concept Attainment is a model which gives more emphasis on the development of thinking strategies. In his model material is presented before the students through labelled examples. On the basis of these labelled examples students form some hypothesis of the concept. After that they themselves give more examples of the concept and thus confirm the hypotheses formed. In this model data or material is so organised that students find ways for themselves to speculate the hypothesise. Brunner and his associates have given full emphasis on the theories of learning and psychology of learning. Development of cognitive structure facilitates learning, here high mean of the group taught through Concept Attainment model of teaching may be due to the relationship among the facts and ideas already presented in the cognitive structure. Kendler and Kendler (1975) are of the view that the Brunner's model is to maximise the information obtained for each instance which reduces cognitive strain and regulates the risk. This may be the reason of the success of the model.

Biological Science Inquiry model is a model which has more impact of Biological Science Curriculum Study. They develop a method of teaching which requires students' maximum involvement in the study than the teacher. Here the teacher is a passive instructor and student is an active learner. J. Schwab (Joyce & Weil 1985) on the basis of the recommendations of the Committee gave a new model of teaching, Biological Science Inquiry model, which requires the students to learn discipline by practising the methods used by biologists. This model is found more effective than the Conventional teaching but it is not more effective than the Concept Attainment model. This may be due to the reason that VIII class students are not so mature that they can do all the laboratory experiments themselves and many times they lose their interest due to successive failure of the study, whereas in the Concept Attainment model all the facts are presented before the students which act as a good clue for the learners. Traditional teaching is not as effective as these two models. This may be due to the novelity in teaching. Monotonous teaching many times loses the interest of pupils in the subject. "Learning by doing" is practised here, as in the case of Biological Science Inquiry model students learn by doing.

CONCLUSION

Concept Attainment model is found to be the most effective with respect to the achievement of students and Biological Science Inquiry model is found more effective than the Conventional teaching.

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Save Ozone Ban Freons

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Ozone, an invisible phenomenon miles above our heads, is scattered throughout the atmosphere over 28 km up in the stratosphere. Some scientists claim that 3% Ozone has already disappeared. Holes now appear every spring in the Ozone layer over arctic and antarctic poles If such a damage continues, nobody knows the future threat to human life. Ozone protects and shields us from harmful Ultraviolet (UV) radiations.

Does more fridges in the developing world mean less Ozone in stratosphere ? This is the question of latest concern. Almost every month meetings are being held with top industrial chemists at various places in Europe and United States to asses the devastating effects of compounds used as refrigerants, i.e., chloroflouro carbons (CFC) freons ; solutions are being sought to find a safer substitute, then comes the shutting down of leading companies like ICI in Britain and Du Pont in US involved in manufacture of these compounds till a substitute is worked out.

Ozone, an invisible phenomenon miles above our heads, is scattered throughout the atmosphere over 28 km up in the stratosphere Some scientists claim that 3 % Ozone has already disappeared. Holes now appear every spring in the Ozone layer over arctic and antartic poles. If such a damage continues, nobody knows the future threat to human life. Ozone protects and shields us from harmful (Ultraviolet (UV) radiations. High UV radiations are continuously being removed by a series of photochemical reactions involving oxogen and ozone. In the first step sunlight striking on oxygen breaks it apart into oxygen atoms

$$O_2 \xrightarrow{UV} O+O$$

Radiations are being absorbed and converted to chemical energy. Atomic oxygen being highly reactive forms Ozone with oxygen

$$O_2+O \xrightarrow{UV} O_3$$

The energy released during the reaction is infrared rather than UV. Thus the biologically harmful radiations are converted to safer infrared. Again dissociation of Ozone also absorbs UV and thus scavange more of harmful radiations

$$O_3 \xrightarrow{UV} O_2+O$$

Thus Ozone layer acts as a filter and shields the UV reaching earth. The solar

radiations of 295-320 nm (UV) can cause skin cancers in human. When human skin is exposed to UV, it causes sunburn or erythema, sunburns on constant exposure to UV develop into skin cancers. For 10% decrease in Ozone layer of stratosphere, there will be 20% increase in the mortality of malignant melanoma cancer patients and 30% increase in total skin cancers. In USA several laws have been enacted to discourage use of chemicals which can deplete this protective layer.

There is recent concern that some air pollutants are thinning out Ozone barriers, of particular interest, as mentioned before, are freons ($CFCl_2$, CF_2Cl_2), CFC are stable compounds. This makes them valuable as refrigerants, propellant in aerosol spray and expanding for plastic foam. Its purpose is to provide the pressure that propels the liquid out as a fine mist. These compounds are inert in lower atmosphere but persist for years eventually drifting into stratosphere where the chlorine release break ozone to oxygen alone. Thus, causing damage to ozone layer. Any high concentration of $CFCl_3$ in upper atmosphere could allow large amounts of ultraviolet radiation to reach life support-

$$CFCl_3 + \text{radiation} \longrightarrow CFCl_2 + Cl_2$$

$$2\,O_3 + \frac{\text{Presence}}{\text{of chlorine}}\ 3\,O_2$$

ing earth It has been calculated that such compounds can reduce Ozone by more than 20% over coming fifty years.

Looking at the alarming effects of freons in a treaty signed in Vienna in 1985, 30 countries had agreed that immediate measures should be taken to protect Ozone layer The US, Canada and Scandinavia have already banned freons in aerosol. EEC asked the chemical industries to reduce overall production of freon compounds. Last December meet at Vienna ended with immediate freeze on fully halogenated CFC's the one that cause the most damage to Ozone layer. However, it is feared that leading companies would not agree to this but for their handsome profits, till some substitute is worked out which can be manufactured with ease. Immediate aim of industrial chemists is therefore to look for safer refrigerants and foam blowers which are degradable in environment to harmless products. Du Pont working in this direction has reported that CFC22 has good prospective as it is less halogenated and it lasts only for 3 years as compared to 75 years stability of $CFCl_3$. This compound is preferred as refrigerant in Europe. However, in airconditioning cars it is not a good replacement as it requires heavy equipment because of its high vapour pressure and high specific heat. New compounds though expansive and complicated are economical.

Coming September a plane will fly at a height of 20 km through the Ozone hole in Antarctica measuring Ozone and the trace gases that may effect the hole. If the results of the experiment suggest the need for more stringent measures then an emergency meeting will be held with top industrialists to reach a new Ozone agreement.

Study of the Effect of Creative Teaching Techniques (Bionics) on the Development of Some Personality Correlates of Scientific Creativity

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Creative process is not mysterious. It can be described. It is possible to train persons to think and act creatively. The teacher's attitude and interest are key factors in promoting original thinking. Creativity is a learnt behaviour as well as an attitude which is a very strong personality factor. The personality factors can be cultivated by conscious efforts. Creativity in the classroom is not something that will just happen Research indicates that the conditions for creative thinking must be established by the teacher.

Introduction

Children tend to be naturally creative, but their creativity is dampened in our authoritarian system of education. Guilford has considered creativity as an intellectual ability. In our lecture-oriented teaching there is a very little scope to develop the creative potentials of the children. The qualities or personality traits related to the creative ability of a person have come to light through the procedure of factor analysis. Some researchers also have indicated that a number of characteristics or personality traits found in the creative persons in different fields are common

Creative process is not mysterious. It-can be described. It is possible to train persons to think and act creatively. The teacher's attitude and interest are key factors in promoting origninal thinking. Creativity is a learnt behaviour as well as an attitude which is a very strong personality factor. The personality factors can be cultivated by conscious efforts. Creativity in the classroom is not something that will just happen. Research indicates that the conditions for creative thinking must be established by the teacher.

Evidences have pointed out a common pattern of personality traits among creative person which might have some bearing on creativity in abstract. These personality traits develop at fairly early stage, and the personality characteristics of a young creative child bear similarity to those of creative adults. Their manifestation at this early stage is possible when certain teaching techniques are used.

Problem

This problem ventures to investigate the efficiency of Bionics technique in creating conditions to develop some personality corre-

lates of scientific creativity.

Hypotheses

The following hypotheses have been formulated.

(I) There will be significant change in the dependent variable personality correlates when the students are taught science through Bionics.

The personality correlates being—

1. Self-reliance
2. Dominance
3. Emotional
4. Venturesome
5. Strong super-ego strength.

(II) There will be no significant change in these personality correlates amongst the students that are taught science through traditional method.

Sample

This investigation was concentrated on students of Class IX. The age group was 13+. The two schools were selected from Nagpur city. Initially 250 students of Class IX in these two schools were involved in this study. The groups matched on intelligence variable and creativity were selected for experimentation.

Control group was taught through traditional method, and experimental group through Bionics technique.

Experimental Treatment

Bionics (Gerardin, 1968) was used as organised creative teaching technique for experimental treatment.

Bionics : Bionics can be regarded as an art of applying the knowledge of living systems to solve technical problems. At first Bionics was mainly concerned with practical applications in development of machines based on living systems.

A radar system analogous to an echo sounding mechanism used by a bat or a telephone analogous to ear mechanism can be cited as an example of most profitable applications of Bionics.

In order to design and make a new physical system, it is essential to understand the principles of the system that work in nature and then apply this knowledge for developing analogous physical system, either copied from living model or inspired by living system. It is the process of comparison between the living system and the physical system that makes the Bionics technique more effective in generating new ideas and developing thereby divergent thinking.

TABLE I

Number of Students and the Description of Groups on Various Variables

S. No.	*Variables*	*Groups* *I*	*II*	*III*	*IV*	*V*
1.	No. of student	54	53	42	42	51
2.	Average age in years	13.92	14.00	13.75	14.16	14.08
3.	Mean IQr.	25.7	34.3	34.1	31.8	33.6
4.	Initial Creative ability	148	149	154	156	145

Adaptation of Bionics as Teaching Technique

Phase I : Introduction of new topic

The new topic can be introduced to the class by asking different questions.

Phase II : Direct analogy

After explaining the main principle of the topic, students were asked to name some of the man-made gadgets of machines known to them, that work on same principle. The thinking process of the students started while listing the machines found in their surroundings and working on same principle.

Phase III : Compressed conflict

The students were asked to find out differences between the machines and the living system. The students explained the point of differences.

Phase IV : Self expression

Lastly the students were asked to write down in their own terms the points of similarities and differences in machines and living system taught to them. They were also asked to write down their own suggestions for improving some of these machines for more beneficial use of man. The students write in their notebooks with full freedom of expression.

Bionics technique, adapted as above, was used as one of the teaching practices to study the effect on development of some personality correlates related to the scientific creativity. The duration of experimentation was one academic session.

Analysis of Data

The groups thus selected for experimentation the pre- and post-test data were collected, on the variables—(i) Self-reliance, (ii) Dominance, (iii) Emotional, (iv) Venturesome, (v) Super-ego strength C Jr. Sr. H.S.P.Q. KVCJ 1980, Hindi edition Form A and B) prepared by S D. Kapoor, S. S. Srivastava and G.N.P. Srivastava were used to collect pre- and post-test data.

In order to compare the performance of the students in the pre- and post-tests, the statistical significance of the differences between the means of pre- and post-test scores on the variables was found out by t test.

The result of anaylsis shown in tables II and III.

TABLE II

Means, Standard Deviations and t Values Between Pre- and Post-test Personality Variables of Experimental Group (Bionics)

N=39 df=38

S. No.	Variables	Pre-test M	Pre-test S. D.	Pre-test SE_M	Post-test M	Post-test S.D.	Post-test SEM	t Value
1.	Emotional	50.07	11.58	1.86	53.69	7.60	1.22	1.60
2.	Dominance	50.20	10.43	1.67	53.20	9.37	1.50	1.49
3.	Strong super-ego strength	52.08	9.98	1.60	53.92	8.98	1.44	0.90
4.	Venturesome	52.10	8.99	1.44	51.67	9.50	1.52	0.20
5.	Self-reliance	51.08	11.29	1.81	48.79	8 53	1.37	0.95

$*P < \cdot 05$

TABLE III

Means, Standard Deviations, and t Values Between Pre- and Post-test Personality Variables of Control Group (Traditional Method)

N=38 df=37

S. No.	Variables	Pre-test M	Pre-test S.D.	Pre-test SE_M	Post-test M	Post-test S.D.	Post-test SE_M	t Value
1.	Emotional	49 07	10.10	1.64	47.97	10.34	1.68	0.51
2.	Dominance	50 26	9.22	1.50	48.00	9.29	1.51	0.93
3.	Strong Super-ego Strength	48 89	8.50	1.41	44.53	9.74	1.58	2.01*
4.	Venturesome	50.68	10.80	1 75	48.76	8.16	1.32	0.84
5.	Self-reliance	50.39	10.13	1.64	51 45	10.20	1.66	0.41

*$P<.05$

Findings

The result reported in Table II reveals that the experimental group taught science through Bionics has shown increase in post-test scores on the variables (i) Emotional, (ii) Dominance, (iii) Super-ego strength.

This group has shown slight decrease in post-test scores on the variables—(i) Self-reliance, (ii) Venturesome. However, these changes are not significant at 0.05 level.

It is to be pointed out here that the gains in post-test scores on variables (1) Emotional, (2) Dominance,(3) Super-ego strength indicates positive movement of their development, while decline in post-test scores on the variable self-reliance indicates positive movement of its development.

The above findings have shown that Bionics groups have shown positive movement of development of four personality variables.

The control group was taught science through traditional method has shown general decline in post-test scores on the variables—(1) Emotional, (2) Dominance, (3) Super-ego strength, (4) Venturesome.

This group has shown slight gain in post-test score on variable—self-reliance; thereby indicating negative movement of its development. Mean differences between pre- and post-test scores on personality variables except super-ego strength, are not significant.

Conclusion

It may be concluded from the above results that the traditional method does not help to develop any of the personality correlates that are supposed to be related to creativity on the contrary, it has shown decline on all the variables, while Bionics technique helps to develop four personality correlates out of five. Bionics technique may prove to be the suitable teaching technique for the development of personality traits related to scientific creativity.

Suggestions

1. Experimental studies with larger sample and longer duration should be

undertaken to provide stable and better results.

2. Accurate indentification of creative potential and effective use of appropriate teaching techniques to nurture creativity should be the prime concern of education.

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Light and Colour

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Visible light is a small band of electromagnetic waves with wavelengths lying between 4000 A° to 7000 A°. Our eyes sense everything within this range. The retina of the eye is receptive to colours through two types of cells—the rods and the cones. To extend the breadth and depth of our observation, various optical instruments are devised as an aid to our eyes.

Introduction

As we grow the curiosity arises in us about the natural phenomena associated with light and colour ; which are not only fascinating but are the remarkable wonders of nature.

Visible light is a small band of electromagnetic waves with wavelengths lying between 4000 A° to 7000 A°. Our eyes sense everything within this range. The retina of the eye is receptive to colours through two types of cells—the rods and the cones. To extend the breadth and depth of our observation, various optical instruments are devised as an aid to our eyes

Light and colour produce psychological effects like sensations of sadness and rejoice in human beings. Artists use colours and shades in paintings to stimulate these physiological changes in us. Nature is a store-house of colours and their combinations. Whenever we observe the sun, the insects, the animals, etc., we find everything colourful. Production of artifical colours, the dyes, the coloured fluorescent tubes, etc., add life in us. In a way, life is a genesis of colours and love is an originator of life. Therefore let us love people irrespective of their colours.

Eye as Detector

Human eye is the most familiar instrument to detect the visible spectrum The retina which is responsible for colour sensation has rods and cones (cells).

Rods are sensitive to white or its absence (darkness), e.g., moonlit night gives sensation through rod cells, while cone cells are triggered off by lights of different colours. All the natural and man-made colours are detected with their help.

Perception of Colours

Though the mechanism by which we appreciate colours is not fully known, yet the one suggested by Thomos Young and developed by Helmholtz is most acceptable one. According to this trichromatic theory

the blue, red and green types of sensory zones discriminate colours. These are called as primary colours. Combination of two of these primary colours gives secondary colours, e.g., blue+green gives cyan, blue+red gives magenta and green+red gives yellow. That particular colour which on addition to secondary colour gives white is called as complimentary colour.

Colour prints exhibit colour by virtue of the fact that some part of the spectrum is absorbed by substraction, and the reflected part of it is absorbed by the eye. World of colours around us is mainly perception of substraction of colours.

Colour television functions on the principle of addition of primary colours. While in colour printing, mixing based on colour substraction can be observed In colour photography all the three primary colours are developed independently and then we see the combined effect of all of them. In some male population colour blindness—lack of detection of red, green and brown colour, is caused due to non-functioning of all the three receptor zones. Most of the animals perceive the things in grey shades or in black and white.

Colour from Sky and Landscape

Scattering of sunlight thro ugh smoke gives blue colour. When smoke is seen in bright background it appears yellow We see different colours of clouds due to scattering at the time of sunrise or sunset. The sky appears blue above earth, but from moon it looks dark. The colour of rainbow is due to multiple reflection of sunlight through hanging droplets in atmosphere.

Sources of Light and Their Spectrum

There are various sources of light, e g., the sun electric bulbs, fluorescent tubes. Each element has its own characteristic spectrum. The spectra of sun is continuous, with dark lines due to absorption spectra of various elements present around the sun. Fluorescent tubes gives colour of gas vapour present inside it. The emission spectra is caused due to excitation of electron in outermost orbit to higher state, and then returning back to its initial state. In the atom, energy is radiated in the form of line spectra. Molecules give band spectra.

Some elements exhibit luminous effect. Luminescence caused in presence of excitation source is called fluorescence, while phosphorescence is caused when the source is cut off.

Types of luminescence are decided on the basis of modes of excitation used e.g., thermolumenescence (heat), electro-luminescence (electricity) etc., we observe various types of plants and animals which are luminous during day time or darkness. Television screen and laser works on the principle of luminescence

Colour Change in Plants and Animals

Colour change in animals is brought up by :

(i) Removal of existing pigments from integuments and replacing them by new ones.
(ii) Redistribution of pigments in the integuments.

Heat, light, background colour, crowding and diet bring in morphogenetic colour change in animals, e.g., in lizard, snakes, etc. In some animals like chameleon, prawn, etc., kinetic colour change is observed due to abrupt redeployment of pigments.

The colour of plants is also due to

pigments, which absorb, transmit and reflect light. A list of pigments and their colour association is given as under :

Pigments	Associated Colour
A & B chlorophyll	green
carotenoids	yellow, orange or red.
anthocynins	scarlet, pink, maroon, blue, etc.
flavones	yellow.

Chemical structure of pigments is linked with the colours of the plants. Presence of chlorophyll shows green colour, while carotenoids show cream ivory. About six or seven anthocynins are associated with coloured varieties of sweat-peas.

Unlike plants, animals show colours due to reflection or differaction of light from cell surface. A few types of pigments associated with animal colourations are listed as under :

(i) *Carotenoids* : It has dietary origin. Invertibrates can oxidise dietary carotencides to produce pigments—a characteristic of species. Some insects have green colour, due to combined effect of chromoproteins—one with yellow and another with blue carotenoids. Some fish accumulate carotenoids in their skin and ovaries. In skin they are localised in cells chromatophones and produce patterns of colours in fish. In birds mainly xanthophyll is accumulated. It has its origin in yolk, body fat, liver, eyes and feathers, etc. Lutein is reasonably constant component or birds carotenoids and is generally present in yellow feathers. The red and blue feathers are associated with the accumulation of astaxanthin, canthaxanthin and rhodoxanthin. The carotenoid pigments of mammals are ineffective for colouration as they lack the ablity to transform carotenoids into more oxidised products.

(ii) Melanin is responsible for black colour.

(iii) Quinones, specially napthaquinones contribute for colouration in animal kingdom.

Coloured Chemical Compounds

Transition metals and their compounds usually absorb light in visible range and are therefore coloured. In infrared and ultra-violet, they appear white Due to absorption, red wavelength show blue-green while green wave length show purple colour of metals. The colours of hydrated ions of some of them e.g. Fe (ii)-green, Fe (iii)-violet, Cu (ii)-blue, etc., help in identifying them.

Colours in Paintings

Right from the frescoes paintings of ancients to the most modern paintings, the colours and their combinations have been investigated to produce shades and embibe life in stills. An initial stage natural colours were employed, but now creative painters use artificals colours for giving effects like hue (discrimination) tone (colour perception) and tints (shades) in their paintings.

Colour in Everyday Life

Man has synthesised dyes, cosmetics, etc., which contain a set of artificial colours They are used for self make-up and the decoration of the houses. Also colours subconciously influence our emotions, choice of food, etc., we use red colour as a symbol of danger or stop, and green as that of safety and go ahead. "Goethe" has therefore rightly said that "Everything that lives, strives for colour".

Some Interesting Results of Isosceles Triangles

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There are certain theorems which relate to a particular type of triangles like right angled triangles, acute angled triangles, obtuse angled triangles, isosceles triangles, etc. But do we have any theorem on isosceles triangles which holds good to a special kind of isosceles triangles but not to all kinds of isosceles triangles ?

Introduction

Plane geometry is an important branch of mathematics known to man from a very long time. Triangles, quadrilaterals, polygons, etc., were known to our good old mathematicians like, Pythagoras, Appolonious, Euler, Aryabhatta, Bhaskaracharya, etc These mathematicians have contributed invaluable work to the field of mathematics. The theorems of Pythagoras and Appolonious on triangles are very famous and have much practical applications.

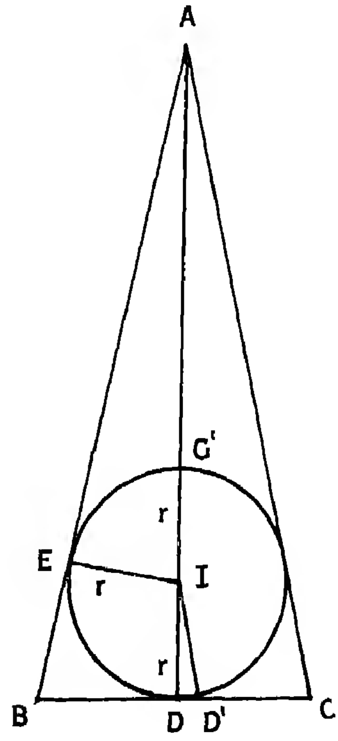
Now we have a number of theorems which hold good for all types of triangles. There are certain theorems which relate to a particular type of triangles like right angled triagles, acute angled triangles, obtuse angled triangles, isosceles triangles, etc. But do we have any theorem on isosceles triangles which holds good to a special kind of isosceles triangles but not to all kinds of isosceles triangles ? As a result of investigation we have found out three such theorems, viz. (1) Theorem 1, (2) Theorem 2, (3) Theorem 3.

THEOREM 1

The incircle of an isosceles triangle passes through the centroid if and only if the angle made by the equal sides is $2 \sin^{-1} (\frac{1}{5})$.

Data : ABC is a triangle in which
$AB=AC$ and
$B\hat{A}C=2 \sin^{-1} (\frac{1}{5})$

Let the incircle with I as its centre touch AB and BC at E and D′ respectively.



To Prove. The incircle of the $\triangle$ ABC passes through the centroid

Construction: The median AD is drawn to BC and let it cut the incircle at a point G'. EI is joined

Proof In the $\triangle$ABC since AD is the median,

$\triangle ABD \cong \triangle ACD$

$\therefore B\hat{A}D = C\hat{A}D = \frac{B\hat{A}C}{2}$

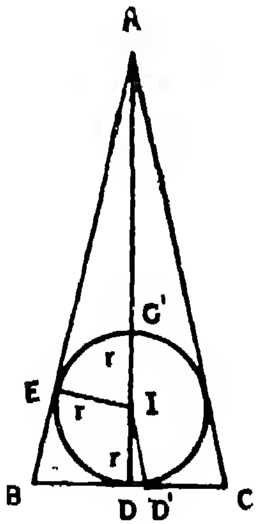
$\therefore$ AD is the angular bisector also of the $B\hat{A}C$

$\therefore$ I, the incentre of the $\triangle$ABC lies on AD

$I\hat{D}B = I\hat{D}C = 90°$ ($\because \triangle ABD \cong \triangle ACD$)

$\therefore ID \perp BC$ ... (1)

D', the point of contact of the incircle with BC is joined to I.



$\therefore ID' \perp BC$ ... (2)

From (1) and (2), $D \equiv D'$

$\therefore$ The incircle touches BC at D*

$E\hat{A}I = \frac{B\hat{A}C}{2}$

or $E\hat{A}I = \sin^{-1}(\frac{1}{5})$, $\{B\hat{A}C = 2\sin^{-1}(\frac{1}{5})\}$

$\sin E\hat{A}I = \frac{1}{5}$

$\therefore$ In the $\triangle$EAI,

$\frac{EI}{AI} = \frac{1}{5}$

$\therefore AI = 5\,EI$

Or $AG' + r = 5r$ ...($\because EI = G'I = ID = r$), where r is the inradius.

$\therefore AG' = 4r$

and $DG' = 2r$

$\therefore \frac{AG'}{DG'} = \frac{2}{1}$

$\therefore AG' = 2DG'$

$\therefore$ G', a point on the incircle of the $\triangle$ABC is the point of trisection also of the median AD.

$\therefore$ G' is the centroid of the $\triangle$ABC and it lies on the incircle.

$\therefore$ The incircle passes through the centroid.

* *Corollary*. If ABC is an isosceles triangle in which AB=AC and AD is the median on BC and G and I are its centroid and incentre, then A, G, I and D are collinear. Here D is also the point of contact of BC with the incircle of the triangle

Proof of the Converse

Data: ABC is a $\triangle$ in which

AB=AC and

the incircle passes through the centroid G.

To Prove: $B\hat{A}C = 2\sin^{-1}(\frac{1}{5})$

Construction: AG is joined and produced to meet BC at D. E the point of contact of the incircle with AB, is joined to I, the incentre.

D is the point of contact also of BC with the incircle (See the corollary)

Proof: EI = DI = GI = r, the inradius.

$\therefore AG : GD = 2 : 1$

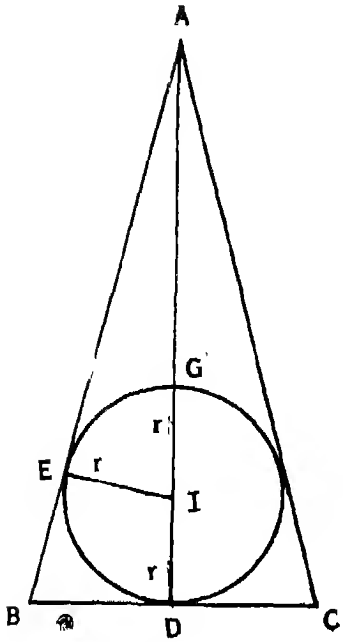
or $AG : 2r = 2 : 1$

$AG = 4r$

$\therefore AI = 5r$

In the $\triangle$ AEI,

$\sin\frac{\hat{A}}{2} = \frac{EI}{AI}$; ($\triangle ABD \cong \triangle ACD$)



Or $\sin\frac{\hat{A}}{2}=\frac{r}{5r}$

$\therefore \frac{\hat{A}}{2}=\sin^{-1}(\frac{1}{5})$

$\therefore B\hat{A}C=2\sin^{-1}(\frac{1}{5})$

THEOREM 2

The excircle bounded by the extended equal sides of an isosceles triangle passes through the circumcentre, if and only if the angle made by the equal sides is 90°.

Data : ABC is a $\triangle$ in which

$AB=AC$ and

$B\hat{A}C=90°$.

To Prove : The excircle (opposite to $\hat{A}$) of the $\triangle ABC$ passes through the circumcentre.

Construction : AS′ is drawn $\perp$ to BC and it is produced to D.

Proof : Let the excircle of the $\triangle$ ABC touch BC at a point S.

In the isosceles $\triangle$ ABC since $AS' \perp BC$,

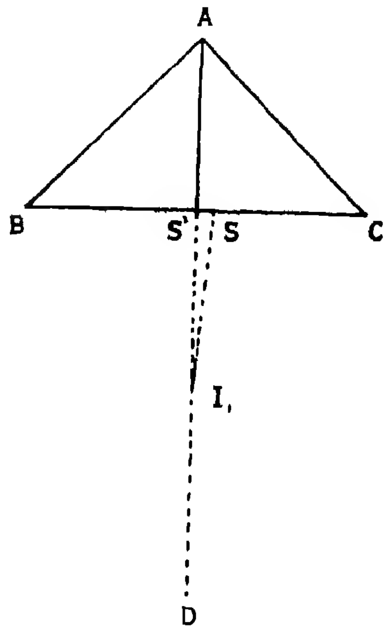
$\triangle ABS' \cong \triangle ACS'$

$\therefore BS'=CS'$ and

$B\hat{A}S'=C\hat{A}S'=45°$ ... (1)

($\because B\hat{A}C=90°$, Data)

$\therefore I_1$, the excentre of the $\triangle ABC$ lies on



AD, the angular bisector of $B\hat{A}C$ as well as the perpendicular bisector of BC.

$\therefore I_1 S' \perp BC$... (2)

$I_1 S$ is joined.

Now S is the point of contact of the excircle with BC and SI_1 is the exradius.

$\therefore I_1 S \perp BC$ ... (3)

From (2) and (3),

$S \equiv S'$

In the right angled triangle ABS,

$B\hat{A}S=45°$ [from (1)] and

$A\hat{B}S=45°$ ($\because A=90°$ and $AB=AC$)

$\therefore AS=BS$ ... (4)

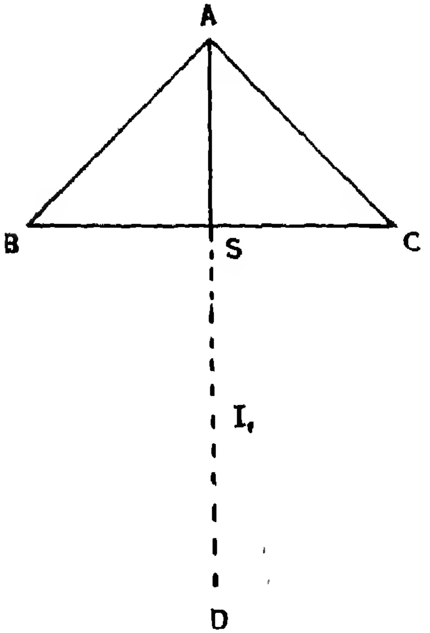
Similarly in the triangle ACS,

AS = CS ... (5)

From (4) and (5),

AS = BS = CS

∴ S is the circumcentre of the triangle ABC.



But the excircle of the $\triangle$ABC touches BC at S.

Therefore, the excircle of the $\triangle$ABC passes through the circumcentre.

Proof of the Converse

Data : ABC is a triangle in which AB=AC and the excircle of the triangle ABC passes through the circumcentre.

To Prove : $B\hat{A}C = 90°$.

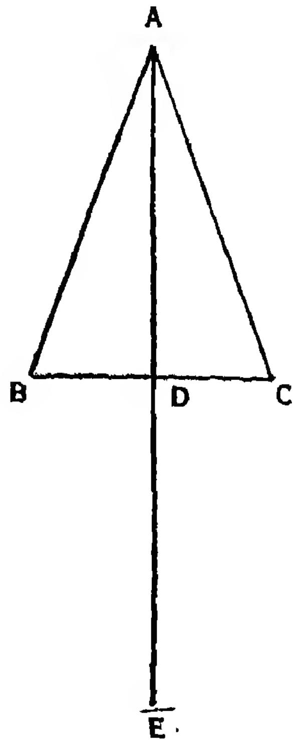
Construction : AD is drawn perpendicular to BC and it is produced to E.

Proof : In the right angled triangles ABD and ACD,

Hypotenuse AB = Hypotenuse AC...(Data)
and AD is a common side for both the triangles

∴ triangle ABD ≅ triangle ACD

∴ BD = CD and
$B\hat{A}D = C\hat{A}D$



∴ AD or AE is both the perpendicular bisector of BC and the angular bisector of angle BAC.

∴ I_1, the excentre of the $\triangle$ABC lies on AE. The excircle of the $\triangle$ABC touches BC at D (Since the perpendicular drawn from the centre of a circle to the tangent, touches the tangent at the point of contact only).

Here I_1 D is the perpendicular and BC the tangent.

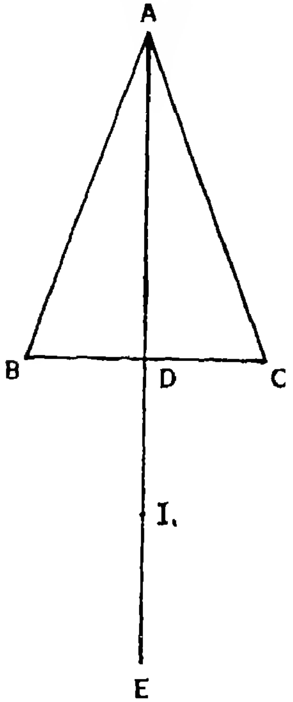
It is given that the excircle of the $\triangle$ passes through the circumcentre.

D is a point both on the perpendicular bisector of BC and the excircle

∴ D is the circumcentre of the $\triangle$ ABC.

DA = DB = DC

and $A\hat{D}B = A\hat{D}C = 90°$



∴ $D\hat{B}A = D\hat{A}B = 45°$

Similarly $D\hat{C}A = D\hat{A}C = 45°$

∴ $B\hat{A}C = 90°$.

THEOREM 3

The incircle of an isosceles triangle passes through the circumcentre, if and only if the angle formed by the equal sides is either equal to 90° or $\cos^{-1} 2(\sqrt{2}-1)$

First Part

Data ABC is a triangle in which AB = BC and

$A\hat{B}C = 90°$

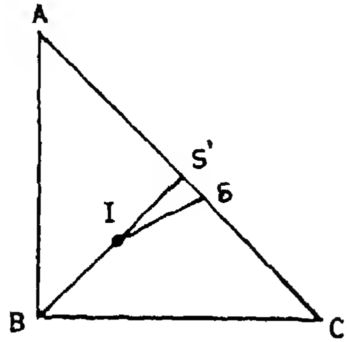
To Prove. The incircle of the triangle ABC passes through the circumcentre.

Construction: BS′ is drawn perpendicular to AC.

Proof. In the right angled triangles ABS′ and CBS′,

Hypotenuse AB = Hypotenuse BC

and BS′ is a common side



$\triangle ABS' \cong \triangle CBS'$

∴ $A\hat{B}S' = C\hat{B}S'$

∴ BS′ is the angular bisector of $A\hat{B}C$ and hence I, the incentre lies on BS′.

Now let the incircle of the triangle ABC touch AC at a point S.

SI is joined.

Now S is the point of contact of the incircle with AC and SI is the inradius

∴ IS is perpendicular to AC

But BS′ or IS′ is perpendicular to AC (Construction)

∴ S ≡ S′

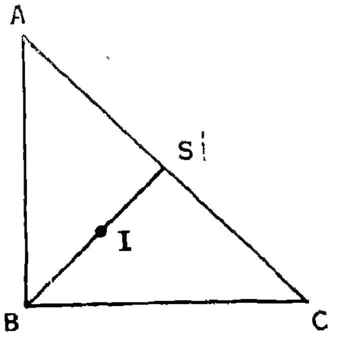
∴ The figure, now, may be redrawn as follows (page 52).

Now, $B\hat{A}S = B\hat{C}S = 45°$ (∵ AB = BC and $A\hat{B}C = 90°$)

In the triangle ABS

$B\hat{A}S = 45°$ and

$A\hat{B}S = 45°$ ... (∵ $A\hat{B}C = 90°$ and BS is the bisector of $A\hat{B}C$)



$\therefore$ AS = BS

Similarly in the triangle BSC,

CS = BS

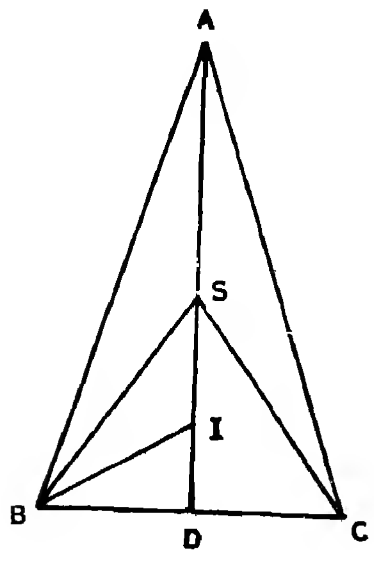
$\therefore$ AS = BS = CS

$\therefore$ S is equidistant from A, B and C hence S is the circumcentre of the triangle ABC. But the incircle passes through S.

$\therefore$ The incircle of the triangle ABC passes through the circumcentre.

Second Part

Data : ABC is a triangle in which AB = AC and $B\hat{A}C = \cos^{-1} 2(\sqrt{2}-1)$



Let AD be the perpendicular drawn from A on BC.

Let the incircle of the triangle ABC cut AD at a point S

To Prove : S is the circumcentre of the triangle ABC.

Proof : In the right angled triangles ABD and ACD

Hypotenuse AB = Hypotenuse AC...(Data) and AD is a common side for both the triangles.

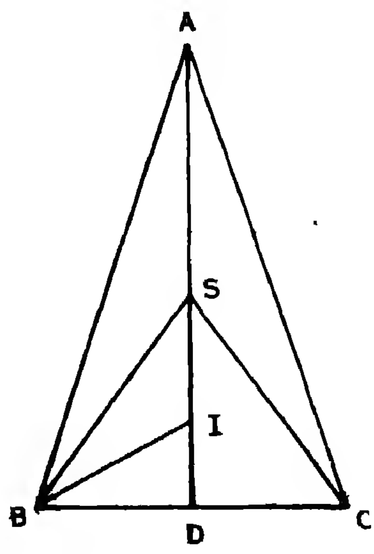
$\therefore \triangle ABD \cong \triangle ACD$

$\therefore B\hat{A}D = C\hat{A}D$ and BD = CD

$\therefore$ AD is both the angular bisector of $B\hat{A}C$ and the perpendicular bisector of BC.

$\therefore$ I, the incentre of the triangle ABC lies *on AD.*

$\therefore$ BS, CS and BI are joined.



Now in the triangle ABC, $\frac{\hat{A}}{2}+\frac{\hat{B}}{2}+\frac{\hat{C}}{2}=90$

or $\frac{\hat{A}}{2}+2\,\frac{\hat{B}}{2}=90^\circ$ ... $(\because \hat{B}=\hat{C})$

$\therefore \hat{B} = 90^\circ - \frac{\hat{A}}{2}$

$\therefore \frac{\hat{B}}{2} = 45^\circ - \frac{\hat{A}}{4}$

In the triangle BSD,

$\tan B\hat{S}D = \frac{BD}{2r}$ where r is the inradius

$\therefore BD = 2r \tan B\hat{S}D \qquad \ldots \qquad (1)$

In the triangle BID

$\tan \frac{\hat{B}}{2} = \frac{r}{BD}$

$\therefore BD = \frac{r}{\tan \frac{\hat{B}}{2}} \qquad \ldots \qquad (2)$

From (1) and (2)

$2r \tan B\hat{S}D = \frac{r}{\tan \hat{B}/2}$

$\therefore \tan B\hat{S}D = \frac{1}{2 \tan \hat{B}/2}$

$= \frac{1}{2 \tan (45^\circ - \hat{A}/4)},$

$\left(\because \frac{\hat{B}}{2} = 45^\circ - \frac{\hat{A}}{4}\right)$

or $\tan B\hat{S}D = \dfrac{1}{2\left\{\dfrac{\tan 45^\circ - \tan \frac{\hat{A}}{4}}{1 + \tan 45^\circ \tan \frac{\hat{A}}{4}}\right\}}$

or $\tan B\hat{S}D = \dfrac{\left(1 + \tan \frac{\hat{A}}{4}\right)}{2\left(1 - \tan \frac{\hat{A}}{4}\right)} \qquad \ldots (3)$

Now $\cos B\hat{A}C = 2(\sqrt{2} - 1)$ ... (From Data)

$\therefore \cos \frac{B\hat{A}C}{2} = \sqrt{\sqrt{2} - \frac{1}{2}}$

or $\cos \frac{A}{4} = \sqrt{\dfrac{1 + \sqrt{\sqrt{2} - \frac{1}{2}}}{2}}$ $(\hat{A} = B\hat{A}C)$

$\therefore \tan \frac{A}{4} = \sqrt{\dfrac{1 - \sqrt{\sqrt{2} - \frac{1}{2}}}{1 + \sqrt{\sqrt{2} - \frac{1}{2}}}}$

On simplification

$\tan \frac{A}{4} = \dfrac{\sqrt{\frac{3}{2} - \sqrt{2}} - \frac{1}{2}\sqrt{8\sqrt{2} - 11}}{\frac{3}{2} - \sqrt{2}}$

Substituting the above value of $\tan \hat{A}/4$ in equation (3) we get

$\tan B\hat{S}D = \dfrac{1 + \dfrac{\sqrt{\frac{3}{2} - \sqrt{2}} - \frac{1}{2}\sqrt{8\sqrt{2} - 11}}{\frac{3}{2} - \sqrt{2}}}{2\left[1 - \dfrac{\sqrt{\frac{3}{2} - \sqrt{2}} - \frac{1}{2}\sqrt{8\sqrt{2} - 11}}{\frac{3}{2} - \sqrt{2}}\right]}$

or $\tan B\hat{S}D$

$= \dfrac{\frac{3}{2} - \sqrt{2} + \sqrt{\frac{3}{2} - \sqrt{2}} - \frac{1}{2}\sqrt{8\sqrt{2} - 11}}{2[\frac{3}{2} - \sqrt{2} - \sqrt{\frac{3}{2} - \sqrt{2}} + \frac{1}{2}\sqrt{8\sqrt{2} - 11}]}$

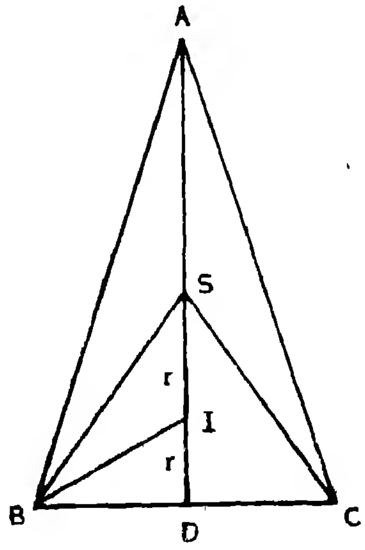
We have $\tan B\hat{A}C$

$= \dfrac{\sqrt{8\sqrt{2} - 11}}{2(\sqrt{2} - 1)} \ldots \left\{\begin{array}{l}\because \cos B\hat{A}C \\ = 2(\sqrt{2} - 1)\end{array}\right\}$ by data.

On simplification, it is found that

$\tan B\hat{S}D = \tan B\hat{A}C = 0.676$

$\therefore B\hat{S}D = B\hat{A}C$



or $B\hat{S}D + C\hat{S}D = 2\ B\hat{A}C$ ... $(\because C\hat{S}D = B\hat{S}D)$

$\therefore B\hat{S}C = 2\ B\hat{A}C$

$\therefore$ S is the circumcentre of the triangle ABC

Proof of the Converse

Data : ABC is a triangle in which

AB=BC and

the incircle of the triangle ABC passes through the circumcentre

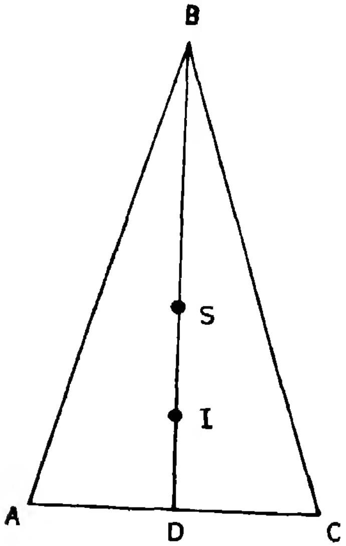
To Prove . $A\hat{B}C=90^\circ$ or

$A\hat{B}C=\cos^{-1} 2(\sqrt{2}-1)$

Construction : BD is drawn perpendicular to AC

Proof. In the right angled triangles ABD and CBD,

Hypotenuse AB=Hypotenuse BC



and BD is a common side for both the triangles.

$\therefore \triangle ABD \cong \triangle CBD$

$\therefore$ AD=CD and

$A\hat{B}D=C\hat{B}D$

BD is both the perpendicular bisector of AC and the angular bisector of $A\hat{B}C$.

$\therefore$ I, the incentre of the triangle ABC lies on BD

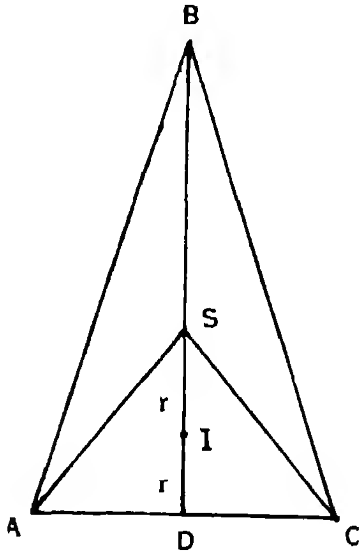
Let the incircle of the triangle ABC cut BD, the perpendicular bisector of AC, at D and S

$\therefore$ Either D or S is the circumcentre of the triangle ABC.

First let us take that D is the circumcentre of the triangle ABC.

$\therefore$ DA=DB=DC=R,

(R is the circum radius) We have $A\hat{D}B=90^\circ$



$\therefore D\hat{A}B=A\hat{B}D=45^\circ$ ... ($\because$ DA=DB)

Similarly $C\hat{B}D=45^\circ$

$\therefore A\hat{B}D+C\hat{B}D=45^\circ+45^\circ$

$\therefore A\hat{B}C=90^\circ$

Now let us take that S is the circumcentre of the triangle ABC.

SA and SC are joined

Now, $A\hat{S}C=2A\hat{B}C$, or $\frac{A\hat{S}C}{2}=A\hat{B}C$

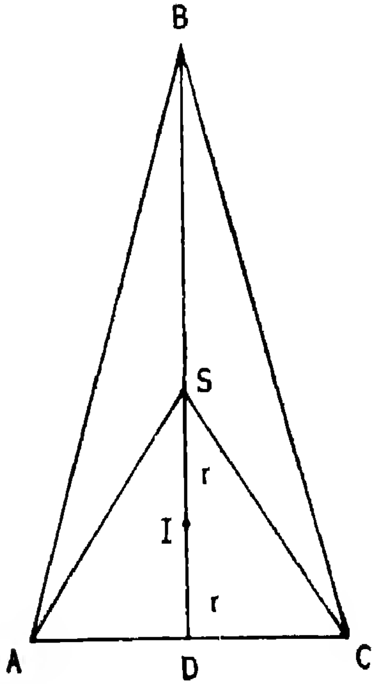
$A\hat{S}D=A\hat{B}C$ ... ($\because \triangle ASD\cong\triangle CSD$)

Now, $\cos A\hat{S}D=\frac{SD}{AS}=\frac{2r}{R}$

($\because$ AS=R, the circum radius)

or $\frac{\cos ASD}{2} = \frac{r}{R}$ ... (1)

Since it is given that the incircle of the



triangle ABC passes through the circum-centre,*

$SI = r$

or $SI^2 = r^2$

But $SI^2 = R^2 - 2Rr$

$\therefore R^2 - 2Rr = r^2$

or $R^2 - 2Rr + r^2 = r^2 + r^2$

or $(R - r)^2 = 2r^2$

$\therefore R - r = \sqrt{2}\, r$

or $\frac{r}{R} = \sqrt{2} - 1$

Substituting the above value of $\frac{r}{R}$ in (1),

$\frac{\cos ASD}{2} = \sqrt{2} - 1$

$\cos A\hat{S}D = 2(\sqrt{2} - 1)$

$\therefore A\hat{S}D = \cos^{-1} 2(\sqrt{2} - 1)$

$\therefore A\hat{B}C = \cos^{-1} 2(\sqrt{2} - 1)$

...($\because A\hat{S}D = A\hat{B}C$).

* Page No 245 of Elementary Trigonometry by H.S. Hall and S R Knight

CHEMISTRY SCRABBLE PUZZLE

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Christ Church College, Kanpur 208 001

Hidden in this alphabet block are the names of 57 chemical elements. They may be spelled backwards, forward, up, down or in any direction on a diagonal. To find the ones you missed, consult the full list in the key given.

CHEMISTRY SCRABBLE PUZZLE

M	M	U	I	L	E	H	N	E	P	T	U	N	I	U	M	U	I	R	A	B
U	A	X	E	N	O	N	E	I	N	S	T	E	I	N	I	U	M	A	A	M
I	N	D	I	U	M	A	O	A	T	T	H	A	L	L	I	U	M	A	U	A
H	Y	D	R	O	G	E	N	A	I	R	N	A	M	E	R	I	C	I	U	M
T	O	B	O	R	O	N	I	A	T	O	O	A	A	K	S	C	B	A	H	A
I	A	E	N	I	T	A	T	S	A	N	G	G	A	C	N	O	B	R	A	C
L	A	N	T	H	A	N	U	M	N	T	R	Z	E	I	I	P	D	A	N	H
A	A	A	N	E	G	Y	X	O	I	I	A	A	A	N	C	P	A	I	I	O
W	F	A	A	A	M	A	A	L	U	U	A	A	C	G	A	E	Z	Z	U	L
R	L	E	A	D	U	A	A	Y	M	M	U	I	D	O	H	R	S	A	M	M
E	U	R	O	P	I	U	M	B	Z	E	A	A	A	L	B	A	A	I	A	I
N	O	U	M	L	B	A	U	D	S	A	A	G	A	D	A	A	A	I	I	O
C	R	B	U	A	R	A	I	E	Z	H	A	F	N	I	U	M	L	A	A	M
I	I	I	I	T	E	A	N	N	A	A	A	R	S	E	N	I	C	T	A	E
U	N	D	M	I	G	A	O	U	N	O	C	I	L	I	S	I	L	V	E	R
M	E	I	D	N	A	A	L	M	E	N	D	E	L	E	V	I	U	M	A	C
A	A	U	A	U	P	H	O	S	P	H	O	R	U	S	A	A	U	A	A	U
A	A	M	C	M	A	A	P	R	A	S	E	O	D	Y	M	I	U	M	A	R
O	S	M	I	U	M	Y	T	T	R	I	U	M	U	I	B	R	E	T	T	Y

Key to Chemistry Scrabble Puzzle

Americium
Xenon
Lanthanum
Mendelevium
Indium
Hydrogen
Einsteinium
Boron
Silver
Lead
Osmium
Hafnium
Arsenic
Phosphorus
Yttrium
Praseodymium
Neptunium
Thallium
Europium

Iodine
Niobium
Manganes
Zinc

Lithium
Nickel
Polonium
Argon
Cadmium
Erbium
Tin

Oxygen
Rhodium
Ytterbium
Barium
Silicon
Astatine
Helium
Carbon

Nitrogen
Sodium
Magnesium
Cesium
Cobalt

Molybdenum
Neon
Strontium
Titanium
Iron
Copper
Mercury
Hanium
Holmium
Gold
Lawarencium
Fluorine
Platinum
Rubidium

Science News

A New Planet in Solar System

American space scientists have an indication of a tenth planet in the solar system. Code named "Planet X", it is believed to be five-times more massive than earth and orbitting the sun, beyond the planet Pluto, in an irregular way. It may be taking "at least 700 years" to make one round of the sun.

The National Aeronautics and Space Administration (NASA) of the United States said that the evidence of the existence of the tenth planet in the far outer reaches of the solar system is partially based on past unexplained variation in the orbits of Uranus and Neptune, the seventh and eighth outermost planets.

The effect of the tenth planet's gravity on Uranus and Neptune would explain the orbital variation, which astronomers measured over a period of at least a century until 1920. From that year until recently, however, measurements have failed to show any unexplained outer planet variations According to Mr. Anderson, a NASA Scientist this negative data, together with the absencs of gravitational effect on two U S spacecraft now travelling through the outermost part of the solar system, suggest that the orbit of the tenth planet is so distant and elongated that it only nears the sun and known planet every 700 to 1000 years

Mr. Anderson further said the bizarre orbit of the tenth planet is not unique in the solar system. The orbit of Pluto, the most distant known planet from the sun and somewhat smaller than the moon, is inclined 30 degrees above and below the plane of the other planets. And then there is a Triton, the large Moon of Neptune, whose orbit is highly inclined and in the opposite direction to other objects the solar system.

Indian astronomers scanning the skies to discover the mysterious 10th planet in the solar system have launched a new project this year according to Dr. R. Rajamohan of the Indian Institute of Astrophysics.

The planet is believed to be responsible for the mass extinction of biological species on earth that occurred millions of years ago. The planet's orbital precession (shifting of the plane of the orbit while revolving around the sun) is supposed to have disturbed a comet cloud leading to a shower of fiery debris some of which struck the earth.

Dr Rajamohan said the entire sky up to the 16th magnitude (an object 10,000 times more faint than the faintest object visible to the naked eye) had been searched in earlier surveys but the 10th planet had not been found. The Pioneer and other interplanetary probes had found nothing to prove that it existed. If it did exist, it was likely to be fainter than the 17th magnitude, he said.

A section of space scientists believe that

the planet exists at a distance of 16,000 km to 32,000 km from the sun and goes round it once in 700 years with a highly inclined orbit. It is supposed to be five times more massive than the earth and is expected to make its closest approach to the sun between the year 2,500 and 2,800.

Biotechnological Achievement

Scientists have developed mice that secrete a sheep protein in their milk, an important step towards making cows produce better milk and even medicines.

The mice were developed by injecting a sheep gene into fertilized mouse eggs. Some mice produced the protein at five times the concentration sheep do In addition, preliminary results suggest that sheap have been made to produce a human protein needed by some hemophiliacs, said Mr. John Clark, principal scientific officer at the Edinburgh Research Station of the Institute of Animal Physiology and Genetics Research in Edinburgh, Scotland. Mr. Clark and colleagues describe the mouse research in the British journal, *Nature*.

The experiment gives evidence that genetically altered animals might give better milk and even produce valuable non-dairy substances in milk.

For examle, such animals may produce more of a milk protein called casein used in making butter and cheese. Other genetic alternations might produce higher calcium content and modified casein that makes cheese mature more quickly.

Non-dairy products could include proteins used in medicine such as factor IX, a blood-clotting substance needed by some hemophiliacs that now is recovered from human blood, he said.

Hepatitis Vaccine Developed

The London School of Tropical Medicine and Hygiene (LSTMH) has developed a simple protein based preparation that can stimulate the body's defences against vital hepatitis. Professor Ariz Zimmerman, Head of the Department of Microbiology at LSTMH, says that the liver cancer is now preventable by using this vaccine.

Of the six viruses that cause the disease, only three have been identified—hepatitis A, hepatitis B and delta hepatitis. The type B, often in conjunction with other types, has the most serious consequences. Sprad by blood or sexual contact, it can lead to persistent liver infection and about 40 per cent of its victims die from chronic liver disease or cancer. Both hepatitis A and B were found to be widespread among the population as a whole and about 57 per cent of children were found to be infected Among adults, however, this proportion had increased to around 94 per cent.

A threat which compounds the already serious hepatitis problem among all age-group is the possible introduction into India of delta hepatitis. If this type of virus infects carriers of hepatitis B, a second liver infection develops and up to 20 per cent of those affected could die. Vaccines against the viruses are available in France, United States and Britain.

Skin Cancer Therapy

Researchers have reported progress in treating a form of skin cancer with a therapy that combines laboratory-produced antibodies with a toxin derived from the castor bean plant.

Dr. Lynn Spitler, Director of the Melanoma Clinic at Children's Hospital of San Frans-

cisco and a senior vice-president of the Xoma Corp said on Thursday the therapy was proving promising for treatment of metastatic melanoma. The cancer, which can spread quickly from a skin mole to internal organs, is difficult to treat with traditional radiation and chemotherapy.

In initial testing in humans, the immunotoxin therapy—usng an antibody developed by Xoma in 1981 and a potent toxin called ricina chain—produced only minor side effects and in more than one-third of the patients a stabilization or shrinkage of the tumours.

In the first phase, 22 patients at Children's Hospital were treated with the immunotoxin, with 10 of them showing a shrinkage or stabilization of tumours.

In the second phase, carried out with 43 patients at the U S. and European medical centres, 13 patients showed evidence of benefits from the therapy. A third phase of testing would begin next year with a larger number of patients.

Youngest Child to Hear Through Bionic Ear

A five year old girl Hally McDonnell becomes the youngest child in Australia to hear through a bionic ear. Hally became deaf after contracting meningitis, inflammation of brain's membrane. With a receiver inserted into one of the inner ears at Sydney's Prince Alfred Children's Hospital, she is now able to detect simple noises like footsteps and voices.

She will soon begin an intensive education programme to enable her to decipher sound.

Dolphins Can do Sums

A Soviet scientist has shown that dolphins are not only more intelligent than dogs but can even do simple arithmetic

Professor Dmitry Fless of Moscow University found offer many years of study on the Black Sea Dolphins that they are capable of predicting the behaviour of other ocean creatures and of thinking logically.

To test their ablities he invented complex experiments, reports APN. Some sea animals were shown a rapidly escaping bait through a narrow opening in a six-metre-wide screen. It took them just a few seconds to evaluate the situation, detour the screen and get their bearings and again to chase the prey. The behaviour of all the four test animals was the same and they did not need any "rehearsals".

Telephone That Also Translates

People who cannot speak a word of each other's language will soon be able to talk on the telephone with a British-invented system. The National Communications Network of Britain demonstrated at its research laboratories what it claimed is the world's first, instantaneous translation of speech by computer. Simple sentences were translated from English to French and from French to English.

The Network said its prototype equipment can also translate English into German, Spanish, Swedish and Italian and it is developing the reverse capability, that will also make possible translation between any pair of these languages.

The equipment consists of a microphone linked to a personal computer which is connected to a telephone circuit capable of handling computer data.

The caller speaks showly into the microphone and the computer repeats the message in a synthetic voice to check if it has under-

stood correctly. It then sends a messags to the distant computer which translates and speaks it. When the other caller replies, the process is repeated in the reverse direction Its system is based on about 400 phrases in common business use, involving more than 1 000 words. The computers are programmed to recognize only 100 key words, which they use to identify the appropriate phrases.

British Telecom is also working on a portable device which tourists could take with them.

Book Review

Children's Knowledge Bank
Volumes I to VI

By

DR. SUNITA GUPTA

DR. NEENA AGRAWAL

Pustak Mahal, Khari Baoli, Delhi-110006.

Paperback . Rs. 20 per volume,

Bound Library Edition : Rs. 30 per volume

This is the age of science and technology. We need conceptual clarity about the events that happened in the past and those that are happenning every moment in the universe The ocean of knowledge is so vast that nobody is able to have confidence of coping up with the expanding horizons of knowledge. But it is also a highly competitive world. Children must maintain the growth rate of standards otherwise they will not be able to keep pace with the events of the world. Knowledge of the growing complexities of our life on this earth, increase in travel facilities resulting in shrinking of the planet, use of satellites in telecommunications, advancements in science and new inventions in technology, knowledge of plants and animals, human body and new researches are given in the *Children's Knowledge Bank*, which enables one to keep pace with ever-increasing global knowledge.

The Knowledge Bank is in 6 volumes. Volume I deals with General knowledge, Geography, Universe and Inventions ; Volume II is divided into five sections, which contain in all 177 questions on General Knowledge, Human Body, Animal and Plant Kingdom, Universe and Space, Sports and Sportsmen. Volume III is divided into six sections and contains 172 questions relating to General Knowledge, Plant and Animal Kingdom, Inventions and Discoveries, Modern Science, Human Body, Sports and Sportsmen. Volume IV is divided into six sections. It deals with 180 questions. One new aspect in this volume relates to Scientists and Inventions. Volumes V and VI cover more or less the same aspects with different content

These six volumes are sufficiently enriched with knowledge in question-answer form. Knowledge is given in very simple English. Once a question is raised in a reader's mind, he feels satisfied only when he reads the given description The answers are so complete and to the point that no doubt is left in cognition which makes the readers satisfied.

The *Children's Knowledge Bank* is useful not only to +2 students, but also to students of VI-X classes for building up their general knowledge.

The sequence of chapters is well thought-out and follows a smooth progression All chapters start with pictures, which are very

communicative.

It is apparent that *Children's Knowledge Bank* is voluminous, but the whole content is organized systematically in 6 volumes so that one volume is not so bulky and can be easily handled by children

Information given about Hockey player Dhyanchand about his birth place is not correct. It is not Allahabad but Jhansi. This is however a minor mistake. On the whole, the books are quite attractive and informative. These can be recommended as source books for school and college-going children in India.

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SCHOOL SCIENCE

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SCHOOL SCIENCE is a quarterly journal published by the National Council of Educational Research and Training. Intended to serve teachers and students in schools with the recent developments in science and science methodology, the journal aims to serve as a forum for the exchange of experience in science education and science projects Articles covering these aims and objectives are invited. Manuscripts, including legends for illustrations, charts, graphs, etc. should be neatly typed double-spaced on uniformly sized paper, and sent to the Editor, SCHOOL SCIENCE, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi 110016. Each article may not normally exceed ten typed pages.

The articles sent for publication should be exclusive to this journal.

Illustrations may be limited to the minimum considered necessary, and should be made with pen and indellible Indian ink Photograghs should be on glossy paper, at least of postcard size, and should be sent properly packed so as to avoid damage in transit

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TO OUR CONTRIBUTORS

SCHOOL SCIENCE invites articles from teachers, acquainting students with the recent developments in science and science methodology. The articles should be addressed to Executive Editor, Department of Education in Science and Mathematics, NCERT, Sri Aurobindo Marg, New Delhi-110016.

Designing the Science Curriculum

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What should students learn in science? Science teachers and supervisors must give careful consideration to the breadth of objectives to be emphasized in science Thus, the scope of science lessons and units may be broader or narrower in scope Quality and relevance are two concepts to emphasize in ascertaining the scope of the science curriculum.

Science teachers and supervisors need to develop quality scope and sequence in the curriculum. Scope emphasizes *what* will be taught in ongoing lessons and units There are numerous means of determining the scope of the science curriculum. Sequence stresses *when* objectives will be achieved by learners Objectives should not be too complex for student realization. Nor, should these ends be too easy whereby challenge to learn is laking. Goals need to emphasize that which is new and yet be achievable for students

Scope in the Science Curriculum

What should students learn in science? Science teachers and supervisors must give careful consideration to the breadth of objectives to be emphasized in science. Thus, the scope of science lessons and units may be broader or narrower in scope Quality and relevance are two concepts to emphasize in ascertaining the scope of the science curriculum.

One means in determining scope is to emphasize mastery learning or instructional management systems (IMS) of instruction Managing the curriculum is important to emphasize here Measurably stated objectives need to be chosen by professionals in science education, prior to their implementation in the curriculum With these precise ends, it is possible to measure if a student has/has not attained a precise objective as a result of teaching or instruction.

Science teachers and supervisors determine the objectives prior to instruction. There is no student-teacher planning in selecting the chosen ends. Specificity is salient in writing measurably stated objectives. Ideally, the ends should be written in ascending order of complexity. Objectives not achieved require a revised teaching strategy. This is followed by another assessment to determine if the measurably stated objective has been achieved.

The total number of objectives selected for student mastery emphasizes the scope of the science curriculum.

Sequence and Scope

Sequence is in evidence when teachers and supervisors arrange the objectives for each of the grade levels in the school system. Students need to possess readiness or have readiness developed prior to working on any one of the sequentially arranged objectives. In selected school system, a student needs to master a certain number of objectives prior to being promoted to the next grade level.

A second means of determining scope in the science curriculum pertains the use of the

project method. The project method can emphasize individual endeavours or committee work Project methods are predicated on the philosophy of the student being heavily involved in decision-making. The teacher is a guide and advisor to the student, but does not determine the project to be made.

There are flexible steps to pursue in the project method. First of all, the student must have a purpose or goal in mind to pursue a project. The science teacher may need to clarify the purpose with the involved student. The student needs to have a clear perception of what is to be achieved in the chosen project.

Secondly, after the purpose of the project has been clarified, the student needs to make definite plans on how the activity is to be pursued. The plan must be developed sequentially. Carefully developed plans are important.

Thirdly, after the plans have been made and are acceptable, the student may construct or carry out each step in the plan. Quality work needs to be in evidence in carrying out the plans. Responsible students need to reveal excellent work in the actual making of the project.

Fourthly, the project needs to be carefully evaluted in terms of standards. Self-evaluation by the involved learner is important The science teacher is a guide to aid in appraising the project.

Project Method

The project method emphasizes heavy student involvement in developing a purpose, a plan, the actual implementation of the plan, and the appraisal of the completed project. The science teacher is a stimulater, a challenger, a resource person, a guide, and a helper to assist student achievement.

The total number of planned and completed projects represent the scope of the science curriculum.

A third means in determining the scope of the science curriculum advocates humanism as a psychology of learning Humanists believe that students individually should choose and make decisions in terms of *what* to learn. Learning centers stress humanism as a psychology of learning. Thus, an adequate number of tasks and centers need to be in evidence in a classroom The tasks and centers are developed by the science teacher. However, an open-ended curriculum is in evidence in that the student may plan with the science teacher those activities purposeful to the former.

With an appropriate number of centers, a student may select desired experiences and omit those activities as deemed to be lacking purpose. A humane science curriculum is in evidence if students can make choices as to sequential tasks to pursue. Tasks need to be varied to provide for students of diverse ability and interest levels. A major goal of humanism is to have students become proficient decision makers in pursuing purposeful experiences Concrete, semi-concrete, and abstract activities need to be in the offing for each student at each learning center.

Humanists believe that each person attempts to achieve self-actualization. The student then selects, pursues, and completes tasks to realize the optimal self. Humanism does not believe that the teacher can select objectives, learning activities, and appraisal procedures to aid learners to attain optimally. Rather, the student perceives interest, purpose, and reason in ongoing self selected activities.

The total number of tasks completed at the learning centers represents the scope of the science curriculum.

A fourth method in determining scope reflects a problem solving philosophy. From a rich, stimulating environment, students identify problems. The problems ideally should come from learners. However, a student may accept an identified problem from the science teacher. Students in committees need to solve the problem. In society, problems are identified and

solved by citizens. The classroom should represent a miniature society. Thus, school and the science curriculum is not separated from the real world in society

Problem-solving

There are flexible steps to utilize in problem solving The very first step is to select and delimit the problem After the problem has been chosen, data needs to be gathered. The data may come from experiments and demonstrations in science, reading materials, as well as diverse audio-visual materials and aids. Effort in problem solving endeavours comes from the interests of students. Effort and interest are one and not separate entities

Next, a hypothesis needs to be developed directly related to the problem. Data sources provide content for the hypothesis. Hypotheses are never absolutes but are tentative. Thus, a hypothesis needs to be tested If the hypothesis holds up under testing, it is accepted. If not, the hypothesis may be modified or refuted. If refuted, additional data needs to be acquired to achieve a comprehensive hypothesis.

The total number of problems identified and solved represents the scope of the science curriculum

Science Curriculum

Science teachers and supervisors need to evalute continuously the quality of sequential learnings for students. Inappropriate sequence can make for failure for students when pursuing ongoing learning activities. Optimal learner progress is in evidence if students are able to achieve new challenging objectives without harmful side effects.

IMS emphasizes the arrangement of precise, measurably stated objectives in ascending order of complexity. Each preceding objective and its attainment provides readiness for students pursuing the next ordered objective. Success, according to behaviorists, in learning is due to ordering the objectives so that students will experience minimal failure in learning. An additional objective can be inserted when students experience failure between two precise ends A logical curriculum is in evidence when the science teacher and supervisor sequences learnings for students.

Project method advocates believe that students with teacher guidence will have a purpose, plan, implementation of the plan and evaluation procedures which harmonize with the learner's present level of development A student generally does not implement that which is incomprehensible and lacks meaning. Since the student is heavily involved in choosing projects to complete in science, he/she selects what is feasible and sequential Sequence resides within the student and not within the minds of teachers and supervisors selecting sequential science objectives for the former to achieve. A psychological curriculum is in evidence when stressing sequential learnings for students in the project method.

Humanism, as a psychology of learning, also emphasizes a psychological science curriculum. The student, from among alternatives, selectes sequential tasks to pursue. Sequence here resides within the student since he/she makes choices and decisions as to which tasks to pursue in a selected order.

A psychological curriculum in science is also in evidence with problem solving methods. Problems are selected by the student with teacher guidance The problems, as well as flexible sequential steps in their solving, come from the student, not from the science teacher. The science teacher, however, provides stimulating, readiness experiences for students.

Teachers need to guide students to attain optimally in science whether it be a logical and/or a psychological curriculum. □

Science Education for Social and Cultural Change

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Science offers the possibility of far greater well-being for human race than has ever been known before. Unfortunately, the society is not aware of the gap between potential and actual success in dealing with the new opportunities and problems that increasing knowledge has brought. We have to think what science can do for social well-being. A whole-hearted persuit and application of scientific knowledge might produce social and cultural prosperity of humanity.

Man is a social animal. Education develops abilities in an individual to adjust himself in his environment. It is a life-long process and the individual acquires it through his efforts and experiences in solving day-to-day problems of his life. Education in its one form is the physical, mental and spiritual development of the individual and in another form it is an agency through which all individuals assimilate society's cultural conserve. They preserve it, propagate and transmit it from one generation to another and consequently construct and reconstruct the society. Thus, it is the process of making an individual a fully efficient member of society. Culture is the best thought, feeling, action and a complete way of life which is pure and refined. So, the culture of society and education are the two facets of human effort—culture is modifying and productive, while education brings development and growth. Now we will see how science as a part of education is responsible for social and cultural changes.

There was a time when science was considered the refuge of destitute and was taught to those who were judged inferior in intellect. About the year 1860 Herbert Spencer wrote, "Science forms scarcely an appreciable element in our so-called civilized training" In another place he spoke of science as 'that which our school course left entirely out'.

Popularity of Science Education

After many years of active and persistent effort however science was recognized as a school subject. Now-a-days science is included as a subject in the school curriculum. The reasons for the popularity of science education in school curriculum are :

1. Science provides a unique training in observation and reasoning. It makes people careful and systematic by training them in the coordination of their observations. It teaches the learner to reason from definitely ascertained fact and to form a clear judgement. It imparts a training in truth. These desirable habits acquired as a result of accurate experimentation are often carried over into one's general character and manner of living. Science is also an example of unity between thought and action, as it concerns itself with both theory and application.
2. Science has a great practical value. Herbert Spencer in his essay, 'What knowledge is of most worth' says "the information which the study of science furnishes is comapra-

tively more useful for our guidance in life than any other kind". Some knowledge of the present position and progress of science is necessary to obtain an adequate understanding of the world in which we live. Science is making such great contributions to the prosperity of the human race and is adding so rapidly to the sum total of our knowledge that nobody can afford to neglect the study of this subject.

3. Science is taught in order to provide a training in and knowledge of what is called the scientific method. The method learnt at school will, it is hoped, prove useful later on in estimating social problems.
4. Science has a cultural value. The history of the scientific discovery presents to the imagination vivid pictures of the work of the great men and thus places science in the front rank of humanistic studies. A knowledge of methods of observation and experiment imparted by the study of the different branches of science leads to the development of a logical mind, a critical judgement and a capacity for systematic organisation.
5. One great problem before the educationists is to train the child to use his leisure properly both in his formative years and later in life. Science is a great aid to the teacher in this respect for, many of the subjects with which people occupy themselves out of working hours are more or less directly, connected with science.
6. Lastly, science is useful in that it forms directly or indirectly, the basis of many studies of a purely vocational nature.

To assess the place of science in education we must consider some of the determinative factors of our society which are influenced much by scientific knowledge

Science and Tradition

The effects of science are of various kinds. There are direct intellectual effects of science on society. The dispelling of many traditional beliefs and the adoption of others are suggested by the success of scientific methods. The study of anthropology has made us vividly aware of the mass of unfounded beliefs that influence the life of uncivilized human beings. Due to lack of scientific knowledge illness was attributed to sorcery and failure of crops to angry gods. Human sacrifice was thought to promote victory in war and fertility of the soil, eclipses and comets were held to presage disaster. Similarly, there were so many misbeliefs in our society due to lack of education and scientific knowledge. The diseases like leprosy, tuberculosis, small pox, cholera and plague were attributed to divine displeasure But due to gradual increase of scientific knowledge the rejection of traditional superstition became common among educated men. The diminution of human suffering owing to the advances in medicine is beyond all calculations.

Science and Philosophy of Society

Science to the ordinary man provides the trimmings of life without appearing in any way to affect fundamental issues. To him 'Science' means comfort or speed or safety or increased weapons of destruction. It is thought of in terms of motor cars, anaesthetics or electronic goods like radio, computers or poisonous gas But technological advances have produced so many new problems and so many new opportunities that they create not merely a new physical background but also a new intellectual and moral environment. Although criteria and incentives of moral action remain substantially permanent but technical changes alter completely the resources for envisaging and practising a new social life The gradual adoption of pragmatism or materialism in place of idealism in our society is the result of technological innovations. Due to industrial revolution man has been denied the time to acclimatise his

thoughts and his social morality. Science philosophy is the determinant of so many factors in our society, it causes more changes in society than philosophy itself.

Science and Social Organisations

The instantaneous global communications that penetrate our homes, network of jet airplane routes that bring the very ends of the world within a few hours of each other, giant ships that have drastically reduced the costs of oceanic transportation and thus have brought about a massive upsurge in world-wide economic contacts and intercontinental nuclear missiles of unimaginable destruction are a few items that cause rapid increase in interdependence. While the world is in the process of becoming a single great mass of humanity, a global community is appearing. Increasing inter-dependency in society is generating a feeling of cooperation and formation of associations, unions, clubs etc. at national and international level. The demand of internationalism is the result of inter-dependency and fear of war in the world.

Science and Social Problems

Inspite of scientific advancement and investigations man has not realised the magnitude or significance or changes in his environment. He has failed to see beneath the changing physical surface the deeper problems he has himself created. The problems arising in the physical world are the bi-products of scientific and technological advancement. The problem of population growth, ecological disbalances, environmental pollution, harmful effects of insecticides, pesticides and chemical fertilisers on vegetables, and crops are some examples of a few problems that the present and future generations have to face.

Increasing political and economic oligarchy, social tension, terrorism, fear of nuclear and space war, deterioration in social values etc. are some current social problems we have to solve. In fact society as a whole is lacking in scientific knowledge. It is the proper time to develop scientific attitude in our society to cope with these problems.

Science and Culture

Culture is activity of thought and receptiveness to beauty and human feelings. It is the stabilisation of civilisation. Cultural effects of science are visible in our society The conquest of power is reducing the hours of work and consequently spread of leisure time which must be reckoned with in social reconstruction. Preservation of cultural wealth and its inheritence for future generations has become easy by means of scientific and technological measures.

To summarize the paper we can say that science offers the possibility of far greater well-being for human race than has ever been known before. Unfortunately, the society is not aware of the gap between potential and actual success in dealing with the new opportunities and problems that increasing knowledge has brought. We have to think what science can do for social well-being. A whole-hearted persuit and application of scientific knowledge might produce social and cultural prosperity of humanity. What, then, is the obstacle which empedes our progress towards the realisation of these ends. What is the solution to the problem of adjustment and utilization of new knowledge with which we are showing ourselves so conspicuously unable to deal ? There can be little doubt that the answers to these questions are in our education.

If our administrators are too ignorant of achievements and potentialities of science to make full use of them, then their education has been lacking. If the mass of our people are unscientific, if their minds are riddled with irrational fears and superstitions then

the remedy lies in the school. For, if it is the function of education to make knowledge available for social and cultural ends, ours has been too slow to realise the significance of new knowledge of last two centuries.

To a great extent the failure of our social adjustment arises in a divorce at the school level between this knowledge and creation of a social conscience. It is repeatedly pointed out that science has nothing to do with values and cannot teach people to be good. This is partly true But science can put at the disposal of man knowlege that will enable him to realise his aspirations. If our education is seeking to produce good citizens, it is at present failing in its object. The pioneers of scientific humanism feel that one must first create an entirely new outlook through the basis of education. To prepare the future generations to face challenges, the position of science in schools, its methods, its aims and its achievements must be submitted to the closest scrutiny. □

AIDS : Its Impact on Mothers and Children

DAVID SASSOON

Courtesy : Action for Children
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When AIDS was first "discovered" in 1981, it was thought to be a disease transmitted primarily through homosexual activity. Africa, where the virus is striking women and men in equal numbers, has shown the threat of heterosexual transmission.

Now there is the third generation of AIDS victims . Children. Children are acquiring the disease from infected mothers, either in utero or during birth. Experts have found that two of every three women with AIDS will pass on the fatal disease to their babies.

Since 1980, close to 1,000 infants have been born with AIDS in the United States, and some experts predict that by 1991 the number will be 25,000. In Africa, where far more women have contracted the disease, the rate of infection is astronomically higher. Zambia alone expects to be caring for 6,000 infants with AIDS this year.

There is bit of good news about AIDS. If this incurable disease, which is currently causing a global pandemic, appeared 20 years ago, we wouldn't have had the faintest idea what was going on Thanks to advances in biotechnology, the AIDS virus has at least been identified. But as Jonathan Mann, head of WHO's Control Programme on AIDS, recently said, "That's the end of the good news".

Cases of AIDS, or Acquired Immune Deficiency Syndrome, have now been reported in 74 countries, and it has been estimated that several million people worldwide have been infected with the causative agent of the disease, the human immunodeficiency virus or HIV. Although many nations in Asia have yet to report occurence of the disease, the routes of transmission are wide open Indeed, WHO has warned that "AIDS is knocking on Asia's door".

AIDS is a disease that attacks the body's immune system, rendering a person incapable of fighting off almost any infection--by another virus, a bacterium, a fungus or a parasite. It has proven fatal in 85% of all cases within 2-3 years after it manifests, and hope for a vaccine is still years into the future, if at all possible.

What is particularly alarming is the impact the AIDS pandemic is currently having on mothers and children and how it might have impact on their health and well-being, both directly and indirectly, in the future.

AIDS Striking Mothers and Children

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Now there is the third generation of AIDS victims—Children. Children are acquiring the disease from infected mothers, either *in utero* or during birth. Experts have found that two of every three women with AIDS will pass on the fatal disease to their babies.

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What is also alarming experts is the threat AIDS poses to beneficial interventions which today are saving the lives of millions of children each year Because AIDS can be transmitted through the use of unsterilized needles, extra care must be taken in hospitals, clinics and immunization drives ; many are worried that unfounded fears could drive people away from any contact with hypodermic needles—one of modern medicine's most basic and important tools.

Immunization Deemed Safe and Necessary

Thus far, there has been no demonstrated transmission of the HIV virus as a result of immunization It is thought that this is because properly sterilized injection equipment is widely used, and because relatively small numbers of vaccination are received per child

The Global Advisory Group of the Expanded Programme of Immunization, which includes officials from both UNICEF and the World Health Organization, proposed that "given the benefits of immunization, programmes should continue to try to achieve the highest levels of coverage possible".

Vaccine injections represent, by some estimates, less than 1% of all injections administered in the developing world. The risk of acquiring vaccine-preventable disease is thousands of times greater than the risk of acquiring AIDS. The benefits of immunization far outweigh the minuscule risk of acquiring AIDS through vaccination, and vaccinations have already saved thousands of lives in Africa.

Nevertheless, in the world's developing nations, AIDS is still being transmitted through contaminated blood transfusions and exposure to unsterilized needles, as well as from infected mothers to newborns. The battle against AIDS in the South is more complicated, more expensive, and more urgent.

Education—One Key to Halting Transmission

The basis of protection is education, and education needs communication—even about a subject like sex which is not a part of public discussion. Ever since the AIDS virus was "discovered" in 1981, standards of acceptable discourse have been evolving in the news media. What words can be printed ? Uttered on television ? Spoken on the radio ?

Similarly, a debate has erupted in school boards throughout the United States. Should AIDS education become a part of regular sex education curricula ? Parents, teachers and health officials are struggling to determine just how to properly educate children about such a sensitive topic

African Nations Start to Respond

In Africa, too, AIDS is becoming a topic of wide discussion Initially silent about the virus, governments in countries particularly affected are becoming aggressive about combating the spread of AIDS, where incidence is second in absolute numbers only to the United States.

In Rwanda, the government, in collaboration with the Norwegian Red Cross, began an education programme using television and widely distributed pamphlets, and is now integrating information about AIDS in school curricula and targeting other efforts at women, the segment of the population most afraid of, but least informed about the disease.

In Uganda, the new government of Yoweri Museveni is encouraging open research. And in Zaire, the government is permitting the first human tests of a potential AIDS vaccine.

While this new openness is welcome, it comes as a response to an already well-entrenched problem. It is estimated that close to 100,000 adults in Kinshasa, Zaire, have been infected with AIDS, and in one study in Kigali, Rwanda, 18% of blood donors showed the presence of the AIDS antibody World health experts hope to begin the fight against AIDS in other nations before the disease becomes so widespread.

Screening of Blood Supplies a Priority

In addition to public education, therefore, the World Health Organization, the lead agency in the campaign to combat AIDS, has launched a global campaign to clean up blood supplies. In some areas of Africa where HIV is prevalent, the chance of contracting AIDS from a blood transfusion is an astonishing 1 in 10. Storage and processing facilities for blood in Africa, as in most parts of the developing world, are rudimentary.

It costs about US$6 to screen one pint of blood for the virus, adding roughly 25% to the cost of blood transfusions, and it requires special equipment and training of laboratory and medical personnel.

WHO's global programme calls for US$1.5 billion annually—several times its current annual operating budget—to accomplish this task. A quick response to WHO's efforts is an urgent priority for the medical establishments in all nations, whether AIDS is currently prevalent or not. Policy makers are being asked to mobilize their health delivery system to respond.

Prostitution Poses High Risks

Another area of great concern to health experts is prostitution. Research in Kenya conducted between 1980 and 1985 showed an increase from 4% to 59% of the prevalence of the AIDS antibody among prostitutes in Nairobi.

Prostitution could become a dangerous avenue for the transmission of AIDS to the population at large. At the same time, it puts many mothers and children at risk. It is no secret that many—prostitutes are themselves little more than children. This is the most horrifying possibility—prostitutes infected with AIDS, many of them mere children, giving birth to more children born with the fatal disease

AIDS is challenging mankind in a way that disease has never done before It is threatening the efficacy of some of modern medicine's most fundamental tools of healing ; it is testing the ability of mankind to work cooperatively on a global scale , in short, this simple biological development is affecting the behaviour of individuals, communities, and nations. ☐

Teaching Hypotheses Making and Testing in Science to Children

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A hypothesis has been defined differently in research literature. According to Beveridge (1961), hypothesis is the most important mental technique of the investigator. Its main function is to suggest new experiments or new observations. Most experiments and many observations are carried out with the deliberate objective of testing a hypothesis. Hypotheses making and testing are the two integrated processes which play important role in scientific inquiry. The objective of introducing students to hypotheses making and testing during science instruction are many. Some processes of hypotheses making and testing are discussed in this paper

National Policy on Education 1986 has emphasized the need to strengthen science education at school stage so as to develop in the children certain abilities, attitudes and values including "the spirit of inquiry, creativity, objectivity, the courage to question and an aesthetic sensibility" These components of science teaching have been stressed time and again ever since science teaching was included as a compulsory curricular area in 1975 upto high school But the realisation of these goals has not been effective enough, hence their reiteration in 1986 NPE policy document. Why have we not been able to achieve the desired objective ? There is need to deliberate upon this issue of science teaching at the school stage. One vital question is about the nature of science we are emphasizing in our schools. Is the product or process of science more important ? It appears that science teaching is predominantly product oriented in our schools. During the sixties an important outcome of the group working under American Association for Advancement of Science (AAAS) was 'Science a Process Approach' (SAPA).

The philosophy underlying SAPA is that what is taught to children should resemble what the scientists do, that is, the processes they carry out in their attempt to make discoveries. Scientists observe, classify, measure, infer, predict, make hypotheses and perform experiments. If scientists collect information in this way, the elementary forms of what they do can also be learnt by the children at the primary stage. This does not mean that we are aiming at making every individual a scientist in the true sense of the term. Instead, it puts forward the idea that the development of scientific creativity may be possible because students will be able to look upon and deal with the work in the ways that the scientists do. At the same time, it is now felt that 'process-driven' approach tends to split the science content into fragments and bits with the result that the form of science takes precedence over concept based knowledge (Survey Report of US High School Students). For this reason, it will be better if a proper balance between content and form is maintained as both these aspects are equally important. Out of the many processes, only the processes of hypotheses making and testing are discussed in this paper.

A hypothesis has been defined differently in research literature. Some of the common defini-

tions are : 'tentative ideas', 'shrewed guesses', 'imaginative ideas', 'trial ideas', 'mental tools' or 'models', 'propositions', 'scaffolds' and 'temporary bridges'. According to Beveridge (1961), hypothesis is the most important mental technique of the investigator. Its main function is to suggest new experiments or new observations. Most experiments and observations are carried out with the deliberate objective of testing a hypothesis.

Success Stories

When we study the history of discoveries and inventions made in the field of science and medicine during the past century, we find that these discoveries and inventions originated mainly from the hypotheses. Hypotheses proved instrumental in building scientific knowledge. In other words, it was the hypotheses making capacity of the inventor which brought him success. Beveridge has collected episodes from the lives and work of various scientists to highlight the role that hypotheses have played in enriching our knowledge of science and medicine.

Loffler (Beveridge, 1961) suggested that death was caused by the toxins produced by the bacteria called diptheria bacillus. Emile Roux performed numerous experiments following Loffler's hypothesis. He could not prove this hypothesis. Finally he injected 35 ml. of culture filterate into a guinea pig. Roux saw the animal die due to lesions of diptheria intoxication. He was able to find out that by prolonged incubation he could produce powerfully toxic filterates. The discovery led to immunisation against diptheria and also the therapeutic use of antiserum. Another scientist, Claude Bernard (Beveridge, 1961), worked on the hypothesis that impulses pass along sympathetic nerves and set up chemical changes producing heat in the skin. He cut the cervical sympathetic nerve and expected the cooling of the rabbit's ear. To his surprise the ear on that side became warmer. Actually he had disconnected the blood vessels of the ear from the nervous influence which normally holds them moderately contracted resulting in a greater flow of blood and hence warming of the ear His hypothesis took a different direction which added to our knowledge of physiological psychology.

Scientific Inquiry

Hypotheses making and testing are the two integrated processes which play important role in scientific inquiry The objective of introducing students to hypotheses making and testing during science instruction are many. The students should be able to

— Distinguish between inferences and hypotheses.
— Construct a hypothesis, given a set of observations/or inferences.
— Distinguish between observations that support a hypothesis and those that do not.
— Construct a revision of a hypothesis on the basis of observations that were made to test the hypothesis.
— Construct and demonstrate a test of a hypothesis.

Thinking about observations lead to seek causes for events. To broaden their understanding of their environment, they generalize their statements and explanations. This process of generalization is what is called formulating hypotheses. Hypotheses may be formulated on the basis of observations or inferences. For example, you may observe that sugar dissolves faster in hot water than in cold. From such an observation, the children might formulate a hypothesis that all substances soluble in water will dissolve faster in hot water than in cold water. There is another example of a hypothesis. If you invert a glass jar over a burning candle the candle goes off after burning for a short while. One of the several inferences that you might make to explain this is that the candle went out because all the available oxygen in the air of the jar was used up. A

hypothesis based on this inference might be that burning candles covered with glass jars go out when all of the oxygen in the jar is used up.

Testing a hypothesis, that is, generalization from an inference also involves conducting a test which will provide data that will support or refute a hypothesis. In the case of hypothesis about burning a candle under the glass jar it is necessary to test the air in the jar after the candle has stopped burning to see whether or not oxygen is present. This experiment was conducted and found that oxygen is indeed present even after the candle has gone out The hypothesis is, therefore, not supported. When data collected does not support a hypothesis, the hypothesis must either be modified or rejected. In the case of the hypothesis about the dissolving time of substances in water, if some exceptions are found, the hypothesis might be revised to say, "Most substances soluble in water will dissolve more quickly in hot water than in cold water". Similarly, hypothesis about burning might be modified to state, "Candles under inverted jars go out when the amount of carbon dioxide in the air of the jar increases to 3%. All these hypotheses could be tested. Further, suppose you want to discuss why soaked gram seeds swell in size ? You may tell the students of class VI that some gram seeds which were soaked in a 500 ml. glass container had 300 ml. water in it. The teacher may ask the students to examine the seeds carefully by feeling and looking at and record their observations, questions about these seeds which they would like to discuss. Some of the probable questions may be as follows :

— How do the soaked and unsoaked seeds differ ?
— Why do the soaked and unsoaked seeds differ ?
— Are the soaked seeds filled with water ?
— Are there holes in the skin ?
— Is water made up of small particles ?
— How did the liquid get into the soaked seeds ?
— Do the containers still contain 300 ml. water ?
— Why did the dried seeds swell ?

The teacher asks questions one by one The students will probably not have answers, but they would suggest some hypotheses to test these. When a hypothesis is suggested the group may be asked to tell whether or not it is a hypothesis. The hypotheses suggested by them may be written on the black-board. These may be as follows :

— All seeds dry up on standing in open air and swell up when soaked in water.
— The out-skin of seeds contain holes large enough for the water to pass through.
— Liquids are composed of particles in motion.
— Water moves through the skin of seeds from where it is plentiful to where it is not.
— Dried seeds swell up in water because they absorb water.

Select one of these hypotheses and ask each of the group to plan a test for it. If, for example, hypothesis 5 is selected, the most immediate test would be to measure the water remaining in the container. If it is less than the quantity with which we started, the students may conclude that the hypothesis is supported. The teacher here may point out that the containers were not covered and that some water might have evaporated from the containers. They also may be allowed to conduct as many experiments as time permits.

Evaluating Hypothesis

Objective test-items can be prepared to assess whether or not the students have developed hypotheses making and testing abilities. Sample items, alongwith acceptable responses, are given below :

Examine the following state and put a cross mark (×) in the appropriate box to

indicate whether each statement is an inference or a hypothesis according to the special interpretation given in SAPA

Inference	Hypothesis	Statement
(×)	( )	A ball dropped from a height of 2 meters bounced to only 1.5 meters because some of its energy was lost when it hit the floor.
( )	(×)	White objects absorb less sunlight than black objects.
( )	(×)	All plants, whether green or non-green, use carbon dioxide in their life processes.
(×)	( )	This cube has a density of 3.7 grams per cubic centimeter and therefore will not float in water.

Suppose that your class has been experimenting for several weeks with the growth and development of green plants. One of the students observes (among other things) that plants in the classroom move or bend toward the windows. The student infers that "the green plants in the classroom bend towards the windows in response to light".

Task 2.1. On the basis of this information construct a hypothesis. The hypothesis could be · "The stems of green plants grow towards a light source".

Task 2 2. Construct a test of the hypothesis. The test could be : "Grow three or four types of ten seedlings each in light till each of these has several green leaves. Place five of each type in a dark closet. Place the other five seedlings of each type at one end of a box which is sealed except that it has a circular opening at the end opposite to where the plants are placed. A dark lamp is placed outside the box so that it shines at the opening. The curvature of the stems from the vertical positions is measured periodically, say, every three hours.

Task 2.3. Describe anticipated observations from the experiment which would support the hypothesis. The hypothesis is supported if the stems in the dark do not bend from the vertical position and the stems of the plants in the box bend towards the circular opening through which the light is passing

Task 2 4. Describe anticipated observations from the experiment which could not support the hypothesis. The hypothesis is not supported if the plants in the box with opening for light do not bend towards light, or, the plants bend towards the opposite direction from the opening for light or, both the groups of plants bend

Thus the teachers can identify numerous problems and conduct exercises on hypotheses making and testing with their students.

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Does Light Travel in a Straight Line

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There is more to light than meets the eye. Light consists of extremely small waves whose wavelength is of the order of 5000 Å or 5×10^{-7} m (1 Å$=10^{-10}$ m). This is roughly the size of a virus. On the other hand, it is known that the wavelength of normal audible sound in air is of the order of 0.5 m or more, a million times that of light. This vast difference in their wavelengths gives the common impression that light travels in a straight line though sound does not.

School children have often heard that the basic property of light is that it travels in a straight line. This is also an important property, they are told, which distinguishes light from sound; for example, we can hear a person behind a wall but cannot see him. Shadows are formed due to the rectilinear propagation of light.

The experiment to show that light travels in a straight line is quite a standard and simple one. It is generally performed by students in all schools. We take three cardboards, each with a small hole in it, and fix these to supports so that they stand upright. We take a candle or a bulb and place it on one side of the cardboards, as shown in Fig. 1, and we try to view the candle from the other side. It is seen that the candle is visible only if the holes in all three cardboards are exactly in a straight line. If any one of the cardboards is displaced, the candle cannot be seen.

However, there is more to light than meets the eye. Light consists of extremely small waves whose wavelength is of the order of 5000 Å or 5×10^{-7} m (1 Å $= 10^{-10}$ m) This is roughly the size of a virus On the other hand, it is known that the wavelength of normal audible sound in air is of the order of 0.5 m or more, a million times that of light. This vast differ-

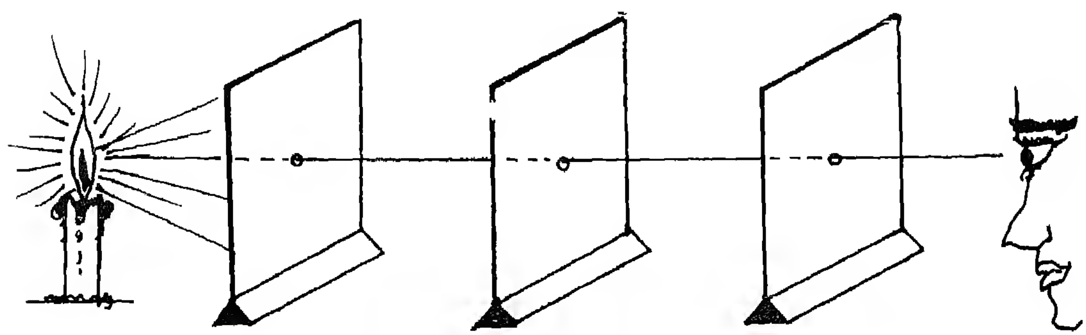


Fig. 1. An experiment to prove lectilinear propagation of light

ence in their wavelengths gives the common impression that light travels in a straight line though sound does not.

It is good to formulate a general principle regarding the ability of waves to bend round obstacles. This principle would apply to all waves—light waves, sound waves, or water waves.

If a wave encounters an obstacle much larger in size than its wavelength, the wave cannot bend round it. Thus two persons standing on the opposite sides of a large building at points A and B in Fig. 2 cannot hear each other. If they go further away from the building (in opposite directions), to points C and D for example, then they can hear each other if their voices are loud enough, because this requires the waves to bend through a smaller angle. This is due to *diffraction* of waves at the corners and edges of an obstacle. In the same diagram, if A is a source of light of wavelength of the order of 5000 Å, even a pinhead or a dust particle would be an obstacle of much larger size than its wavelength ; it would therefore produce a shadow In this case, the waves behave like particles

On the other hand, *when the obstacle in the path of the waves is comparable in size to its wavelength, the waves can bend round it* due to the phenomenon of diffraction as mentioned above. A person at B on the other side of the obstacle can 'hear' or 'see' the source A as shown in Fig. 3, although in a diffused manner. As the size of the obstacle reduces, the hearing or view of A at B becomes more and more clear. Thus sound waves can easily go round obstacles which are a few metres in size, while light waves can do so with obstacles of the size of a micron (upto about five times the wavelength or smaller, in each case).

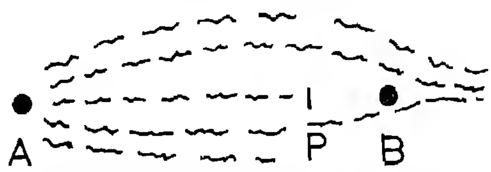


Fig. 3. Waves from a source A meet an obstacle P whose size is comparable to their wavelength.

Finally, *if the obstacle is much smaller than the wavelength of the waves, the waves would pass as if the obstacle did not exist.* The obstacle would be practically unnoticed by the waves.

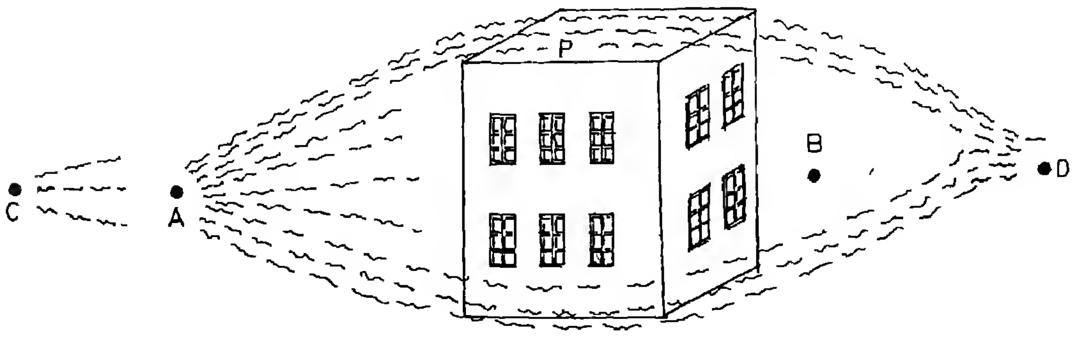


Fig. 2 An obstacle P much larger than the wavelength, in the path of waves , A is the source of the waves. The point B lies in the shadow zone of the obstacle. The point D can collect waves emenated by A after being bent round P, though the intensity would go on reducing with the distance.

Once again, this would depend on the size of the obstacle, and as its size becomes smaller and smaller as compared to the wavelength (say 100 times smaller or less), the diffraction of waves produced at it would become more and more negligible. For example, no diffraction is observed with a small toy or a pencil which has a size much smaller than the wavelength of normal speech sound. Similarly, an atom has dimensions much smaller than the wavelength of light. That is why light does not undergo diffraction when it pass through air or glass (Fig. 4)

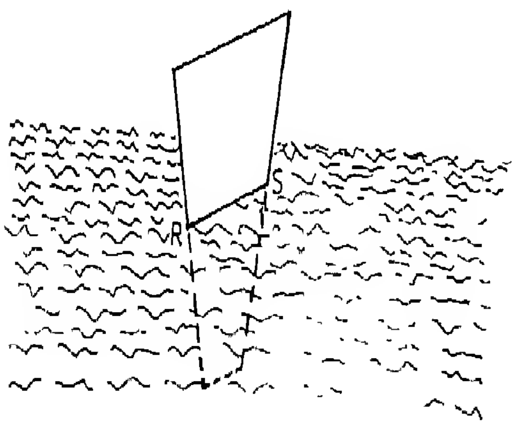


Fig. 4. A tapered plank serves as an obstacle of varying width The obstacle is the line RS where the plank cuts the water surface.

One can perform simple experiments with water waves in a laboratory tank or an outdoor tank as shown in Fig. 4. Waves can be generated at the point A on the water surface (refer to Fig. 3 and imagine the points to be on the water surface) and a vertical plank can be partially dipped at P to serve as an obstacle. The plank P should be tapered off to provide an obstacle of varying size by dipping it more or less in the water. (The obstacle here is *not* the whole of the plank but only its part which cuts the water surface ; the water waves are two-dimensional waves and the obstacle is one-dimensional) All the above-mentioned effects can be studied by—(a) changing the lenght of the obstacle (raising or lowering the plank), (b) changing the distance of the source of waves from the plank, and (c) changing the intensity of the waves. □

Indian Children : Some Facts

Courtesy
The State of World's Children 1987
UNICEF
United Nations Children Fund

Today, our world no longer allows millions of its children to die in the sudden emergencies of drought or famine anywhere on the planet Whether the crisis be Kampuchea in 1979-1980 or Africa in 1984-1986, the attention of the mass media ensures that enough of the world's people and enough of the world's governments are moved to the kind of action which, at the very least, prevents mass deaths.

Forty years ago no such ethic prevailed. In the early 1940's, for example, an estimated 3 million men, women and children starved to death in Calcutta and Bengal of which the world knew little and did less.

By far the greatest emergency facing the world's children today is the 'silent emergency' of frequent infection and widespread undernutrition. No 'loud emergency', no famine, no drought, no flood, has ever killed 280,000 children in a week. Yet, that is what this silent emergency is *now doing—every week.*

Now, the time has come for governments and peoples to decide that it is just as unacceptable for so many millions of children to die every year of needless malnutrition and infection as it is for them to die in sudden droughts or famines.

Towards Universal Immunization

In one of India's 420 administrative districts, a group of about fifty people are discussing ways of raising immunization coverage from 25% to 80% or more. On a flip-chart, one of the group is listing suggestions for reaching everybody with the immunization message. Most of those present are medical doctors. But they are not just enumerating health posts. So far, the flip-chart reads : 15 banks, 19 post offices, 22 sports clubs, 4 newspapers, 30 temples, 15 churches, 15 cinemas, 50 schools, 300 teachers, 50 roadside billboards, 2 markets, 4 festivals and carnivals, 8 public address systems, 75 *anganwadi* workers, 3 hospitals, 1 *panchayat* (village council) headquarters, 43 ex-soldiers, 12 youth groups, 4 slide projectors, 24 ration shops, and 24 tin signboards, as well as the district's army of auxiliary nurse-midwives and other primary health care workers.

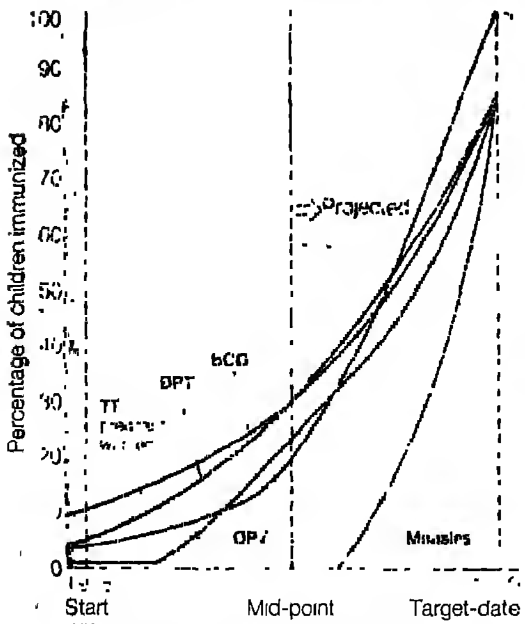
This attempt to mobilize all the resources in each district, and not just its formal health services, is central to India's attempt to reach universal immunization. Since it began in 1978, the nation's Expanded Programme of Immunization has made vaccination accessible to almost every family in the nation. But in practice, only a little over half of all families bring their infants for the first injection and only about three-quarters of those come back for the second and third doses. To deepen the existing coverage will require a massive communications effort to increase the demand. That is why health planners all over India are now beginning to discuss sports clubs and local newspapers—and every other mechanism to reach people with the message about the importance of full immunization and how to obtain it.

The effort to widen the reach of India's existing immunization programme from about 25% to 80% or more is proceeding district by district on a plan designed to cover the nation

by 1990. In 1985, the plan went into action in the first 30 districts and coverage more than doubled to 60% (the population of those 30 districts is almost as great as the combined populations of Colombia and Turkey). In 1986, another 60 districts are taking on the challenge. From 1987 to 1990, approximately 100 districts a year will attempt to reach 85% immunization. Meanwhile, anxious eyes will be cast back to see if the previous years' achievements are being sustained (fig. 16).

Fig. 16 Immunization in India, progress and projections, 1978–1990

India's Expanded Programme on Immunization (EPI) started in 1978 with the aim of immunizing all children under one by the year 1990.



Note BCG - Against tuberculosis (1 dose)
DPT - Against diphtheria, pertussis (whooping cough), tetanus (3 doses)
TT - Tetanus toxoid two injections needed in pregnancy to prevent tetanus of the newborn
OPV - Oral polio vaccine (3 doses).
Measles - Introduced into the EPI in 1986 (1 dose at age nine months).

Source Future issue no 17, 1985–86 UNICEF New Delhi

As each district begins the process, every house is visited to list all pregnant women and children under one—and to personally inform parents of the need for vaccination. That message is reinforced by television and radio advertisements, by posters and public address systems and by all the communications resources of the district. Once demand is increased, it must then be met by increased supply, and the two must be coordinated in a well-managed and sustainable operation.

The total cost of intensifying immunization will be an estimated $750 million over five years—amounting to $5 for each fully immunized child and $3 for each women immunized against tetanus (the aim is to immunize all pregnant women) Once 85% immunization is achieved, the annual cost of maintaining that level will be approximately $150 million—including all salaries, vaccines, organizational costs, and demand creation. The price is a small one; every day in India, more than 3,000 children die of vaccine-preventable diseases and about 250 more are paralysed for life by poliomyelitis alone.

The attempt at universal immunization is an attempt to take advantage of the massive infrastructure of communications and support which India has built up over the last thirty years. For a marginal extra investment in gearing this system to universal immunization, a massive dividend may soon be paid

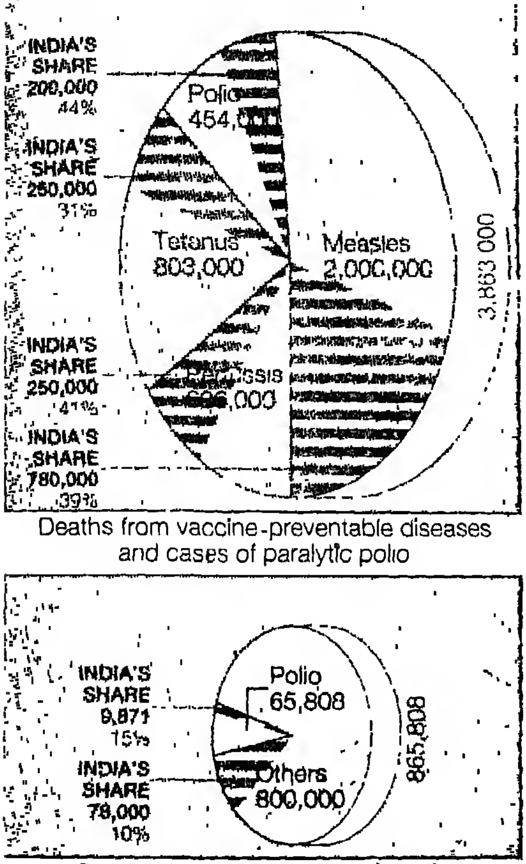
Reaching the Nation

By a crude reckoning, it could be said that more than a quarter of the problem of the world poverty is to be found in just one country. Whether the issue is diarrhoeal deaths or vaccine-preventable diseases, low birth-weight or malnutrition, infant death or childhood disability, nearly 30% and sometimes more of those affected live in India (fig. 19).

But since independence in 1947, India has built a nation with a capacity for social development which could surprise the world over the next two decades.

In industry, India has moved into the top

Fig 19 India's share of vaccine-preventable deaths and disabilities



Deaths from vaccine-preventable diseases and cases of paralytic polio

Deaths and cases of paralytic polio prevented by vaccines

Source: Future Issue no. 17 1985-86 UNICEF New Delhi

en of the world's manufacturing powers. In ıgrıcuture, food production has risen faster han population growth and most harvests now /ield a surplus of basic grains. In social levelopment, a massive infrastructure is now in ›lace—capable of reaching out to inform and upport the great majority of India's families n improving their health, nutrition, and ›roductivity.

Each of the 5,100 'development blocks' vich make up the nation, for example, now has an administrative structure, including usually two primary health care centres with an average of eight subcentres each In manpower, the nation has over a quarter of a million qualified allopathic doctors, and over a million trained community health workers. In education, 80% of India's children now at least start school and 90% have primary education available within one kilometre of their homes. Radio reaches about 90% of the population and television is already in 10% of homes

Adding to this capacity are several social development programmes which have grown to the point where they are now serving a significant percentage of the population, the Integrated Child Development Services scheme, for example, provides basic health care and preschool education to fifth of the nation's children in need. Similarly, the Programme for the Development of Women and Children in Rural Areas serves over 300,000 rural women and is scheduled to double its coverage in three years.

In other words, if the government of India decides to try to achieve a particular development aim it now has an administrative and communication system which gives it a realistic chance of success.

The results are already visible. In little over twenty years, infant mortality has fallen by 30%, life expectancy has risen by 40%, and the birth rate has been brought down by approximately 25%. In only five years (1980 to 1984) the number of villages without safe water supplies has been reduced from an estimated 230,000 to about 40,000 and Indian manufacturers are now producing over 150,000 village water pumps every year.

The government's goals for the year 2000 —goals made practicable by the system now in place—include :

— Halving infant deaths (to 60 or less per 1,000 live births).

The Child Survival Index : A Global Look

The basic measure of infant and child survival is the under-five mortality rate or U5MR (number of deaths under the age of five, per 1,000 live births) A child *survival* rate per 1,000 births can be simply calculated by subtracting the U5MR from 1,000. Dividing this figure by ten shows the *percentage* of those born who survive to the age of five. The following table shows that percentage child survival rate for all countries in both 1960 and 1985.

Percentage of those born who survive to reach the age of five

	1960	1985		1960	1985		1960	1985
Afghanistan	62.0	67.1	Zambia	77.2	86.5	Korea, Dem. Rep. of	88.0	96.5
Mali	63.0	69.8	Peru	76.7	86.7	Korea, Rep. of	88.0	96.5
Sierra Leone	60.3	69.8	Libyan Arab Jamahiriya	73.2	87.0	Panama	89.5	96.5
Malawi	63.6	72.5	Morocco	73.5	87.0	Mauritius	89.6	96.8
Guinea	65.4	74.1	Indonesia	76.5	87.4	Uruguay	94.4	96.8
Ethiopia	70.6	74.3	Congo	75.9	87.8	Romania	91.8	96.9
Somalia	70.6	74.3	Kenya	79.2	87.9	Yugoslavia	88.7	96.9
Mozambique	69.8	74.8	Zimbabwe	81.8	87.9	USSR	94.7	97.1
Burkina Faso	61.2	75.5	Algeria	73.0	88.3	Chile	85.8	97.4
Angola	65.4	75.8	Honduras	76.8	88.4	Trindad and Tobago	93.3	97.4
Niger	68.0	76.3	Tunisia	74.5	89.0	Jamaica	91.2	97.5
Central African Rep.	69.2	76.8	Guatemala	77.0	89.1	Kuwait	87.2	97.5
Chad	67.4	76.8	Saudi Arabia	70.8	89.1	Costa Rica	87.9	97.7
Guinea-Bissau	68.5	76.8	Nicaragua	79.0	89.6	Portugal	88.8	97.8
Senegal	68.7	76.9	South Africa	80.8	89.6	Bulgaria	93.8	97.9
Mauritania	69.0	77.7	Turkey	74.2	89.6	Hungary	94.3	97.9
Kampuchea	78.2	78.4	Iraq	77.8	89.9	Poland	93.0	97.9
Liberia	69.7	78.5	Borswana	82.6	90.1	Cuba	91.3	98.1
Rwanda	75.2	78.6	Viet Nam	76.7	90.2	Greece	93.6	98.2
Yemen	62.2	79.0	Madagascar	81.9	90.3	Czechoslovakia	96.8	98.3
Yemen, Dem.	62.2	79.0	Papua New Guinea	75.3	90.6	Israel	96.0	98.4
Bhutan	70.3	79.4	Ecuador	81.7	90.8	New Zealand	97.3	98.6
Nepal	70.3	79.4	Brazil	84.0	90.9	Austria	95.7	98.7
Burundi	74.2	80.0	Burma	77.1	90.9	Belgium	96.5	98.7
Bangladesh	73.8	80.4	El Salvador	79.4	90.9	German Dem. Rep	95.6	98.7
Benin	69.0	80.7	Dominican Rep	80.0	91.2	Italy	95.0	98.7
Sudan	70.7	81.3	Philippines	86.5	92.2	USA	97.0	98.7
Bolivia	71.8	81.6	Mexico	86.0	92.7	Germany, Fed Rep of	96.2	98.8
Tanzania, U. Rep. of	75.2	81.7	Colombia	85.2	92.8	Ireland	96.4	98.8
Nigria	68.2	81.8	Syrian Arab Rep.	78.2	92.9	Singapore	95.0	98.8
Haiti	70.6	82.0	Jordan	78.2	93.5	Spain	94.4	98.8
Uganda	77.6	82.2	Mongolia	84.2	93.6	United Kingdom	97.3	98.8
Pakistan	72.3	82.6	Paraguay	86.6	93.6	Australia	97.5	98.9
Oman	62.2	82.8	Lebanon	90.8	94.4	France	96.6	98.9
Lao People's D. Rep.	76.8	83.0	Thailand	85.1	94.5	Hong Kong	93.5	98.9
Zaire	74.9	83.0	Albania	83.6	94.8	Canada	96.7	99.0
Cameroon	72.5	83.8	China	79.8	95.0	Denmark	97.5	99.0
Togo	69.5	84.0	Sri Lanka	88.7	95.2	Netherlands	97.8	99.0
India	71.8	84.2	Venazuela	88.6	95.5	Norway	97.7	99.0
Cote d' Ivoire	68.0	84.3	United Arab Emirates	76.1	95.7	Japan	96.0	99.1
Ghana	77.6	84.7	Guyana	90.6	95.9	Switzerland	97.3	99.1
Lesotho	79.2	85.6	Argentina	92.5	96.0	Finland	97.2	99.2
Egypt	70.0	86.4	Malayasia	89.4	96.2	Sweden	98.0	99.2

— An average of two children per family (nearly 23 million babies are born in India every year—more than in the whole of Latin America and almost as many as in the whole of Africa).
— Halving the number of women who die in childbirth or of 'maternal causes'.
— Significantly reducing the 30% incidence of low birth-weight and child malnurtrition (emphasizing prevention rather than rehabilitation).
— Primary education for all and eradicating illiteracy (with a special effort to reach illiterate women and to prevent girls from dropping out of school)
— Safe drinking water for all and basic sanitation for 50% in urban areas and 25% in rural areas

UNICEF's assistance in achieving these goals gives special emphasis to immunization by 1990, the promotion of universal knowledge about diarrhoea management and oral rehydration, and the prevention of malnutrition.

ICDS and the Nation

Of the thousands of projects started every year in the developing world, very few can ever claim that they have permanently and significantly affected the life of a nation. But that is what the Integrated Child Development Services (ICDS) scheme is now beginning to achieve in India.

From small beginning just over a decade ago, ICDS now involves over 200,000 people in promoting basic health care and pre-school education for the poorest 20% of the nation's families. By 1990, the scheme will double in size to reach 40% of all deprived children By the turn of the century, if is scheduled to serve the poor in every village and neighbourhood of India.

The heart of ICDS is the *anganwadi*—literally, the courtyard—which is given or cheaply rented as a centre for information and help with child care An *anganwadi* worker is chosen from the local community (minimum age 18) and given three months' training ; she receives an honorarium of 250 rupees per month (about $20) for four and a half hours' work, six days a week. With monthly retraining visits from more qualified health officials, the *anganwadi* worker is expected to monitor the growth of children, teach mothers how to prevent and cope with common illnesses (including how to use oral rehydration therapy), educate parents to promote their children's normal growth, organize immunizations and vitamin A distribution, treat minor injuries, organize supplementary feeding where necessary, and act as a referral point for getting more qualified help to children with more serious health problems All *anganwadi* centres also provide pre-school education and early stimulation activities for children under the age of six.

Because of its scale, the ICDS has become one of the most studied programmes anywhere in the developing world. Many problems have been highlighted—usually to do with uneven quality of training, supervision, or referral. But independent studies have also concluded that ICDS is making a dramatic impact. Malnutrition in ICDS areas has commonly been found to be 60% less than in areas not yet served by the scheme. Infant mortality has also been reduced to below 90 per 1,000 live births as opposed to a national average of 114—despite the fact that ICDS only operates in poor areas Immunization rates and school enrolment levels are usually higher, and drop-out rates are lower. And there is a small but already noticeable drop in the birth rate where ICDS has succeeded in improving child health and survival.

Although the *anganwadi* is a centre for treatment and referral, its main emphasis is on the promotion of all-round mental and physical development by empowering families with both the knowledge and the necessary support to

protect their own children's normal growth. In combination with today's knowledge breakthroughs in the fields of immunization, breast-feeding, oral rehydration, growth monitoring, weaning and birth spacing, a 'social breakthrough' such as ICDS is showing that it has the potential to significantly reduce child deaths and child malnutrition.

As part of India's 20-point development plan, ICDS is regularly reviewed at cabinet meetings It is therefore seen as a central part of the nation's drive against poverty. When the scheme does finally reach all the poor families of India, it will still cost less that 1% of the nation's gross domestic product.

□

The Relationship Between Attitude Towards Physics and Cognitive Preference Styles in Secondary School Students

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In India researchers have not started working on Cognitive Preference Styles in various science subjects. But in Israel, America and Britain—Heath, Atwood, Tamir, Kempa, Rogel, Brown and Hofstein have conducted much work in this area. In their researches, they have constructed and validated different cognitive preference style tests. In addition, they have studied the relationship of cognitive preference styles with achievement, intelligence and some background variables like curriculum, teacher bias, teachers' cognitive styles, sex etc So far no attempt has been made to study the relationship between attitudes to Physics and the cognitive preference styles of the students Therefore the investigator has attempted the following study.

The development of positive attitude towards subject matter appears to be gaining support as an outcome of schooling. Thus, the systematic measurement of students' attitude towards various subject matters is a pressing demand on researchers. Previously, the attitudes of students towards subject matter was believed to be unimportant. For example, in a needs assessment study conducted with a random sample of citizens, Thomas (1975) found that the attitudes of students towards mathematics was ranked the least important of the six factors studied and these results replicated with samples of principals and teachers

On the other hand, the introduction of 'cognitive preference' construct by Heath (1964) provided a second line of thought to many researchers like Kempa and Dube (1978, Tamir 1974) Cognitive Preference Testing helps in determining the likelihood of student to do with the information intellectually. The construct is regarded as the variant of cognitive style. Cognitive styles are related to the vocational preferences, the choice of specialisation and relative performance within the fields. These predict the direction of achievement and hence provide a potentially powerful basis for career development and guidance.

As far as the knowledge of the investigator goes, in India researchers have not started working on Cognitive Preference Styles in various science subjects. But in Israel, America and Britain—Heath, Atwood, Tamir, Kempa, Rogel, Brown and Hofstein have conducted much work in this area. In their researches, they have constructed and validated different cognitive preference style tests. In addition, they have studied the relationship of cognitive preference styles with achievement, intelligence and some background variables like curriculum, teacher bias, teachers' cognitive styles, sex etc. So far no attempt has been made to study the relationship between attitudes to Physics and the cognitive preference styles of the students Therefore the investi-

gator has attempted the following study "The Relationship Between Attitude Towards Physics and Cognitive Preference Styles in Secondary School Students".

Hypotheses

Following hypotheses were tested—

i. The students having low and high attitudes towards physics differ in cognitive preference styles in the subject.
ii Significant relationship exists between attitude towards physics and cognitive preferences of students.
iii. Significant relationship exist among scores on dimensions of attitude scale namely 'Enthusiasm in physics learning', 'Views on physics as a process', 'Views on physics learning' and 'Attitude towards physicists' and 'Recall', 'Principles', 'Questioning', and 'Application' scores on physics cognitive preference styles test.

Sample

One thousand and seventy-six students of both sex studying in tenth and eleventh classes in different schools of Rajasthan and Central Schools (India) constituted the sample of the study.

Tools

The investigator has developed two instruments whose descriptions are as under :

1. Attitude Towards Physics Scale (ATPS)

A likert type scale was developed for this study At the initial stage 125 statements were prepared on undermentioned four dimensions .

— Enthusiasm in physics learning.
— Views on physics as a process.
— Views on physics learning.
— Attitude towards physicists.

The pool of items was given to ten experienced and qualified teachers. The language of the items was checked by experts. Content validity ratios (C.V.Rs) were calculated by using Lawshe's formula By this initial screening only 60 items were left. After that, these items were administered on a sample of 200 randomly selected students. Item analysis procedure suggested by Edwards (1957) was adopted and finally 35 statements were selected. The reliability coefficient as calculated by a split-half method was found to be 0.852. Internal consistency coefficients were calculated by using Cronbach procedure. Coefficients for above mentioned dimensions were found to be 0.71, 0 81 and 0 83 respectively Inter-correlation coefficients between various dimensions were also calculated.

2. Physics Cognitive Preference Styles Test (PCPST)

The four modes of cognitive preference styles suggested by Heath (1964) served as a blue-print of physics cognitive preference styles test (PCPST) developed and validated by the investigator The modes are—

1. Recall (R)
2. Principles (P)
3. Questioning (Q)
4. Application (A)

Twenty items were prepared. Each item and its statements were discussed with five experts. Internal consistency coefficients for Recall, Principles, Questioning and Application modes as calculated by Cronbach procedure were found to be 0.71, 0.69, 0.80 and 0.90 respectively. Inter-correlation coefficients between the dimensions were also calculated. An example :

Like attraction, a magnet possesses directional property also—

i. **A freely suspended magnet always rests in NS direction.**

ii Mariner's compass, based on directional property of a magnet, is used by navigators.

iii. It makes us think, 'What makes a freely suspended magnet to rest in NS-direction ?'.

iv Directional property well explains the existence of the earth's magnetism

Comparison of Cognitive Preferences

The groups of students having high and low attitude to physics were formed by taking into consideration the mean and the standard deviation of scores. The mean and the standard deviation of scores of 1076 students were found to be 96.82 and 14.50 respectively. Students having attitude scores more than (M + SD = 96.82 + 14.50=111.32) 111 32 were assigned to the group of students having high attitude. Similarly, students having attitude scores less than (M —SD = 96.82 — 14.50 = 82.32) 82.32 were assigned to the groups of students having low attitude to physics. In a sample comprising of 1076 students, 167 fell into high attitude group and 156 into low attitude group Means and the standard deviations of R-Scores, P-Scores, Q-Scores and A-Scores are summarised in table 1. The t-values were also calculated to test the significances of differences in means of R-Scores, P-Scores, Q-Scores and A-Scores of the two groups of students

Discussion

1 High Attitude group and Low Attitude group of students were found to have same cognitive preference styles in physics desired on the basis of their mean scores in Recall, Principles, Critical Questioning, and Application modes. Both groups had first preference 'Recall', second preference for 'Principles', third preference for 'Application' and fourth and last preference for 'Critical Questioning'. So their cognitive preference style was found to be

Recall → Principles → Application → Critical Questioning.

2. As is clear from table 1 that high attitude group and low attitude group differed significantly in their mean R-Scores For 323 df the tabled value of t is 1 644 at .05 level. The calculated value of t (= 2 291) was less than table value 1 644. Therefore, hypothesis of no difference in means of R-Scores of both groups is rejected in the favour of high attitude group.

3. No significant difference was found between the means of P-Scores of high and low attitude groups because for 323 df at 05 level the calculated value of t (= 1.10) did not exceed the tabled value of t (=1.644). The two groups did not differ as far as their P-Scores are concerned

4. No significant difference was found between the means of scores of high and low attitude groups because for 323 df at .05 level the calculated value of t = 0.931 did not surpass the tabled value of t (=1.644) In other words, two groups did not differ as far as their Q-Scores are concerned.

5. No significant difference was found between the means of A-Scores of high and low attitude groups because for 323 df at 05 level the calculated value of t (=0.12) did not surpass the tabled value (=1.644). In other words, two groups did not differ as far as their A-Scores are concerned.

Attitude Towards Physics

1. The correlation-coefficients between "Attitude Towards Physics" (ATP) scores and Recall scores (R), Attitude Towards Physics (ATP) scores and Principles (P), Attitude Towards Physics (ATP) scores and Critical Questioning scores (Q) and Attitude Towards Physics (ATP) scores and Application Scores (A) were found to be .48, .102, —0.25 and .0057 respectively. The correlation coefficients

TABLE I

M, SD and t-Values of Scores on 4 Dimensions of PCPST of High and Low Attitude Groups of Students

Dimension	*High Group*		*Low Group*		*t-Value*	*Significance at .05 Level*
	M	*SD*	*M*	*SD*		
Recall (R)	61.90	11.4018	59 30	8.889	2.291	S
Principles (P)	47.24	5 532	47 90	5 02	1 10	NS
Critical Questioning (Q)	43 5	10 3923	44.43	7 4833	0 93	NS
Application (A)	47.18	6.0415	47 10	5.94	0 12	NS

0.48 and $-.25$ are significant at .01 level of significance

2. The correlation-coefficients between 'Enthusiasm in Physics Learning (E) and Recall scores (R), Enthusiasm in Physics learning (E) and Critical Questioning (Q) and Enthusiasm in Physics Learning (E) and Application scores (A) were found to be 0.13, -0.01, -0.17 and 0.08 respectively. All the four correlation-coefficients are not significant at 01 level of significance.

3. The correlation coefficient between Views on Physics as a Process (VPP) and Recall (R), Views on Physics as a Process (VPP) and Principle scores (P), Views on Physics as a Process (VPP) and Critical Questioning (Q), and Views on Physics as a Process (VPP) and Application scores (A) were found to be 085, $-.032$, $-.086$ and .09 respectively. All the four correlation-coefficients are not significant at .01 level.

4. The correlation-coefficients between Views on Physics Learning (VPL) and Recall scores (R), Views on Physics Learning (VPL) and Recall scores (R), View on Physics Learning (VPL) and Principles scores (P), Views on Physics Learning (VPL) and Critical Questioning (Q), Views on Physics Learning (VPL) and Application scores (A) were found to be .048, .062, $-.015$ and $-.0001$ respectively. None of these correlation-coefficients are significant at .01 level of significance.

5. The correlation coefficients between Attitude Towards Physicists (AT) and Recall scores (R), Attitude Towards Physicists (AT) and Principles scores (P), Attitude Towards Physicists (AT) and Critical Questioning scores (Q), and Attitude Towards Peysicists (AT) and Application scores (A) were found to be .24, -0.064, $-.27$ and .151 respectively The correlation-coefficients 0.15 and $-.27$ were found to be significant at .01 level of significance

Summary of Findings

1. Cognitive Preference Style in Physics of both high attitude and low attitude towards physics groups of students was found to be the same, that is R — P — A — Q It reflected the highest preference for 'Recall' and the lowest preference for 'Critical Questioning' modes of cognitive preference styles.
2. Significant difference was found in the means of "Recall" scores of both high and low attitude towards physics groups.
3. No significant differences were found in the means of "Principles", "Application" and "Critical Questioning" scores of both high and low attitude towards physics groups
4. Low correlation coefficients reflect that there exists no significant relationship between 'Attitude Towards Physics' and modes of 'Cognitive Preference Styles in Physics'.

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The Versatile Number

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Dr. Atul Shaha and his young son Amit were returning from a tour, in their car. As Dr. Atul drove the car he recalled his young age. He told Amit that in those beautiful old days there used to be milestones which were then replaced by kilometer stones. He also told Amit that the relation between a mile and a kilometre is given by the relation :

$$\frac{1 \text{ mile}}{1 \text{ kilometre}} \simeq 1.6$$

While this discussion was going on, their car entered the city. The hotel building which was quite old had been built by a British engineer. After parking the car they entered into the court of the hotel. Amit was pleased to see this marvellous piece of architecture.

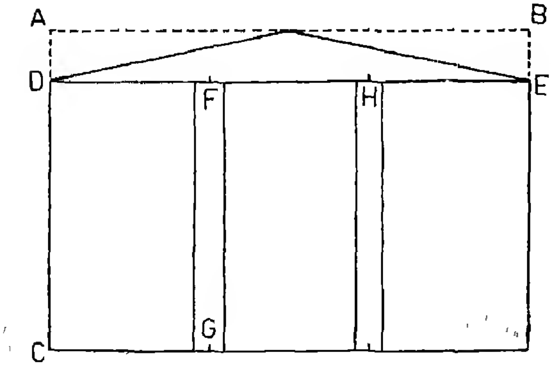

Fig. 1

Dr. Atul told Amit that there was a special principle used in that construction of the building He further told him that for a long time western architects believed that the most beautiful looking rectangle has its adjacent sides in the ratio $1/2\,(1 + \sqrt{5}) = 1.61803$. For this reason this ratio was called a golden ratio In this construction of the building (shown in fig. 1) one finds that :

$$\frac{AB}{AC} = \frac{DC}{DF} = \frac{FG}{FH} = 1.61803$$

Amit was very happy to know this new interesting information. Then, he suddenly exclaimed "See Dad a coincidence—The ratio $\frac{1 \text{ mile}}{1 \text{ kilometre}} = 1.61$ is almost equal to the golden ratio It means that a rectangle 1 mile in length and 1 km in width will be a golden rectangle!" After appreciating this observation Dr. Atul said, "the number 1.61803 of which we are thinking is a versatile number and it appears in many diverse situations". Dr Atul promised to tell him all about this versatile number and he gave him the following information.

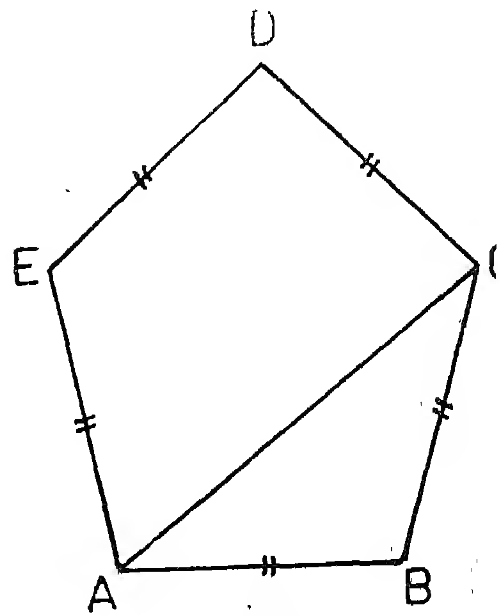

Fig. 2

1. **It shows its face in any regular pentagon.** Thus if ABCDE is any regular pentagon as shown in Fig. 2

Then, $\frac{l(AC)}{l(AB)}=1/2\ (1+\sqrt{5})=2\cos 36^\circ$
$=1.61803$

We can easily show it as follows.

Produce AB upto G such that AB$\cong$BG as shown in Fig. 3

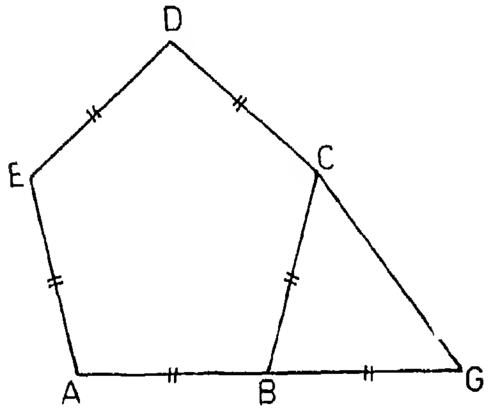

Fig. 3

Then m $\angle$ABC = 108°. ... (angle of a regular pentagon)

$\because$ In $\triangle$ABC, AB$\cong$BC and m $\angle$ABC=108°

$\therefore$ m $\angle BAC = m\ \angle ACB = \frac{180-108}{2} = 36^\circ$

Similarly, in $\triangle$BCG, since m $\angle$GBC=72° and BG$\cong$BC

$\therefore$ m $\angle BCG = \frac{108-72}{2} = 54^\circ$

$\therefore$ m $\triangle$ACB+m $\angle$BCG=36°+54°=90°
or m $\angle$ACG=90°

In $\triangle$ACG, $\frac{l(AC)}{l(AG)}=\sin \angle AGC$
$=\sin \angle BGC$
$=\sin \angle BCG=\sin 54$
$=\sin (90-36)=\cos 36$

Hence $\frac{l(AC)}{2l(AB)}=\cos 36^\circ$

or $\frac{l(AC)}{l(AB)}=2\cos 36^\circ=1.61803$

2. **The picture shown in Fig. 4 shows the double spiraling of the daisy head.** In this flower one finds that two opposite sets of rotating spirals are formed by the arrangement of the individual flowers in the head. There are twenty-one in the clockwise direction and thirtyfour counter-clockwise and the ratio $\frac{34}{21}=1.619$
=the golden ratio

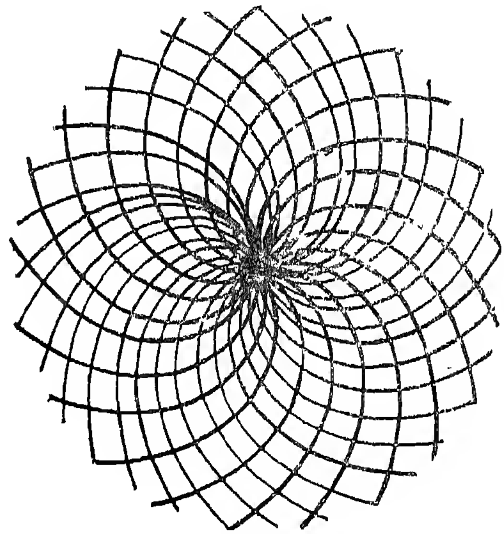

Fig. 4

3. **It appears also in continued fractions** Thus,

$$\text{Golden ratio}=1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{1+1}}}}}$$

4. **It appears also in different equations.** Take any two numbers say 1 and 3. Add them to get 4. Now add 3 and 4 we get 7. Again add 4 and

7 to get 11, and so on You obtain the following series of numbers :

1
3
4
7
11
18
29
47
76
123

You will find that as you proceed onwards and onwards the ratio of two adjacent numbers comes closer and closer to the golden ratio,

thus $\frac{29}{18}=1.6161$

$\frac{76}{47}=1.617$

and $\frac{123}{76}=1\ 618$

5. **Multiplication of rabbits and golden ratio.** Suppose we have a pair of rabbits. We will assume the following—

(i) Both the rabbits of our pair are newborn, when we start

(ii) Rabbits begin to reproduce exactly two months after their own birth

(iii) Thereafter every month a pair of rabbits will produce exactly one other pair (one male and one female).

(iv) None of the rabbits die.

Let us see how their increase takes place—

Number of Months Passed	Total Number of Pairs of Rabbits
0	1
1	1
2	2
3	3
4	5
5	8
6	13
7	21
8	34
9	55
10	89
11	144
12	233
13	

Note that $\frac{233}{144}$=golden ratio 1.618

$\frac{144}{89}=1.618$ etc.

6. **Cells of bees and golden ratio.**

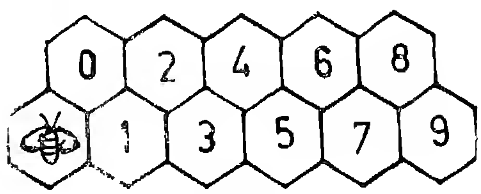

Fig 5

The bee is shown in one cell. If it always moves to the right and always to the cell next to it then let us see in how many different ways can it go to cell no 2 (say)

Path no. 1 — 0 → 2

Path no. 2 — 0 → 1 → 2

Path no. 3 — 1 → 2

Thus there will be three possible paths. If you find one number of possible paths for each cell you will get the following table

Cell no.	No of paths
0	1
1	2
2	3
3	5
4	8
5	13
6	21
7	34
8	55
9	89
10	:
:	

Thus we get a right column of the table which is the same as the right column of table obtained in case of rabbits.

7. **Fibonacci sequence and the golden ratio** We have seen that in case of rabbits multiplication as well as in case of the paths of the bee the right column of the table yields a sequence of numbers, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, ...

The speciality of this series is that when we add any two adjacent numbers of the sequence, the addition gives the next number of the series. Thus,

$$1+1=2$$
$$1+2=3$$
$$2+3=5$$
$$3+5=8$$
and so on

In other words—$a_n + a_{n+1} = a_{n+2}$

This list of numbers with its special properties was discovered by a 12th century Italian mathematician. His name was Leonardo da Pisa (Not Leonardo da Vinci, who drew the famous portrait of Mona Lisa). His nickname was Fibonacci, and hence this series is called a Fibonacci series, and in it $\frac{a_{n+1}}{a_n}$ yields a golden ratio when n is fairly large. One can draw a rectangle on paper, with its sides having a ratio equal to the golden ratio in the following way.

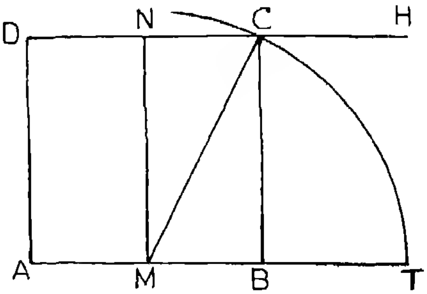

Fig. 6

Draw a square ABCD having each side of length P. Now join the midpoints of AB and CD by a line MN. Draw a circle with centre M and radius equal to MC. If this circle cuts AB produced in T then complete the rectangle ATHD which is a golden rectangle.

Proof to show that,

$$\frac{l(AT)}{l(AD)} = 1/2\,(1+\sqrt{5})$$

$$l(AB)=l(AD)=P$$

Now, $[l(MC)]^2=[l(MB)]^2+[l(BC)]^2$ ...(Pythagoras)

$$=\left(\frac{P}{2}\right)^2+P^2$$

$$=\frac{5}{4}\,P^2$$

$$\therefore \quad l(MC)=\frac{\sqrt{5}}{2}\,P$$

$$\therefore \quad l(MT)=l(MC)=\frac{\sqrt{5}}{2}P$$

$$=\frac{P}{2}+\frac{\sqrt{5}}{2}\,P$$

$$=1/2\,(1+\sqrt{5})\,P$$

$$\frac{l(AT)}{l(AD)}=\frac{1/2\,(1+\sqrt{5})\,P}{P}$$

$$=1/2\,(1+\sqrt{5})$$ □

Srinivasa Ramanujan—Jewel Amongst Mathematicians

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Once an arithmetic teacher was explaining to his students, 'if we divide 3 bananas amongst 3 boys, each will get one Similarly, if we divide 1000 Pineapples amongst 1000 boys, then each one will get one. In other words a number divided by itself is unity'. A boy asked 'Sir, is zero divided by zero also equal to one. That is, if no banana is distributed among no boys, will each boy still get one banana?' The teacher replied, 'the answer is 'no' but mathematically each boy will get an indeterminate number of bananas'. The boy who asked this question was Srinivasa Ramanujan

Ramanujan was born on December 22, 1887 in a poor Brahmin family at Erode near Kumbakonam in Tamil Nadu. His father was an Accountant to a cloth merchant at Kumbakonam and his mother was a woman of strong common sense.

Ramanujan began his schooling at the age of five. He was a quiet and meditative student with an extraordinary memory power. At the age of 13, he was able to get Loney's 'Trigonometry' from a college library He not only mastered the book but also proved theorems and formulas of his own. Unknown to him, these theorems and formulas had been proved earlier by famous mathematicians. He devoted most of his time to mathematics and sometimes for days together he would be fully engrossed in serious mathematical thoughts He would hurriedly take his meals and even leave them unfinished to pursue his brain waves. At school senior students used to get their difficulties in mathematics removed by him. The most significant moment in his life came when a senior student showed him a book entitled 'Synopsis of Elementary Results in Pure and Applied Mathematics' by G.J. Carr Ramanujan was very delighted and he verified the results given in the book. He discovered many other formulas and theorems which he noted down in his notebooks. He passed his matriculation in the first division at the age of 16 from Madras University and won the 'Junior Subramaniam Scholarship'. Ramanujan joined F.A. (First Examination in Arts) Class in Government College, Kumbakonam. The course of study consisted of Mathematics, Psychology, History of Rome and Greece, English and an Indian language. He showed his aptitude and skill for mathematics in the College but neglected his other subjects with the result he failed in the annual college examination He was disappointed. He joined Pachiappa College in Madras but again failed in the F.A. University examination

He returned to Kumbakonam and persisted with his interest in mathematics by scribbling in his notebooks which later became famous as Ramanujan's 'frayed notebooks'. His father thought that the best way to get him out of it was to marry him off. So he was forced to marry a nine year old girl named Janaki.

Now Ramanujan needed money not only for his boarding but also for stationary to do his calculations. He needed about 2000 sheets of paper every month. Sometimes he would pick up papers from the street and write on them. He would even use a red pen to write over what was written in blue ink. He began looking for a job He would show his 'note-books' to his prospective employers as a proof of his mathematical ability for a clerical job. But he was refused appointment because none understood his notebooks

At last he was introduced to Dewan Bahadur R Ramachandra Rao, Collector of Nellore District and President of the Indian Mathematical Society. He recognised his genius and said later, "In the plentitude of my mathematical wisdom I condescended to permit Ramanujan to walk into my presence. A short uncouth figure, stout, unshaved, not over-clean, with one conspicuous feature—shining eyes—walked in with a frayed note-book under his arm. He was miserably poor He had run away from Kumbakonam to get leisure in Madras to pursue his studies. He never cared for any distinction. He wanted leisure; in other words, that simple food should be provided for him without exertion on his part and that he should be allowed to dream on". Ramachandra Rao undertook to pay for his expenses and he used to send him money every month. Meanwhile he was able to get clerical job on a monthly salary of Rs. 25 in the office of the Madras Port Trust. But he never slackened his work in mathematics. Later some teachers and educationists interested in mathematics prevailed upon the University of Madras to grant Ramanujan a monthly research fellowship of Rs. 75 from May 1, 1913.

A few months earlier Ramanujan had written a letter to the famous mathematician G.H. Hardy at Cambridge University in which he set out 120 theorems and formulas. He requested Professor Hardy to publish these results if possible. Among them were Reimann series invented by a German Mathematician, G.F. Reimann and other formulae already known. But Ramanujan was unware of all these mathematical developments which he had discovered on his own. However, there were many original theorms about which Hardy narrates, 'I had never seen anything in the least like them before. A single look at them is enough to show that they could only be written down by a mathematician of the highest class'. It included Ramanujan's conjucture about the equation called "modular" which was proved to be correct by Pierre Deligne. He also gave key formula for Hyper-Geometric series which became known after his name. Properties of Numbers, Partition of Numbers, Elliptic Integrals, Continued Fractions, Magic Squares and several other such topics of mathematics engagaged his thoughts before he went to Cambridge University. On March 17, 1914 Ramanujan went to Cambridge University where he worked with Professor G.H. Hardy and Professor Littlewood Ramanujan did not find it comfortable at Cambridge. The cold was too hard to bear and being strictly vegetarian he had to cook himself to which he was not accustomed.

Ramanujan first appeared to be unwell in the Spring of 1917. He was sent to Sanatoria at Wells at Matlock and in London. It was found that he had contracted tuberculosis which was an incurable disease those days. However, Ramanujan never slackened his work in mathematics and continued his research activity even on death bed. According to Hardy, Ramanujan could remember the idiosyncrancies of numbers in an almost uncanny way. Once Hardy went to see Ramanujan in a sanatorium in Putney. He told him, 'Ramanujan I came in a taxi-cab No. 1729. It seems to me rather a dull number. I hope it is not an unfourable omen'. Ramanujan immediately said, 'No Hardy, it is not a dull number. It is a very interesting

number It is the smallest number expressible as a sum of two cubes in two different ways'. That is,

$$1729 = 12^3 + 1^3 = 10^3 + 9^3$$

That is why Professor Littlewood had remarked that 'every positive integer was one of his personal friends'.

Ramanujan was elected Fellow of the Royal Society on February 28, 1918 at the early age of thirty. He was the first Indian to be elected a Fellow of the Trinity College, Cambridge on October 13, 1918 which carried an honorarium of £250 a year for six years.

In 1919 Ramanujan was sent back to India since the climate of England was not favourable for his recovery. On April 26, 1920 he died at Chetpet in Madras. Thus, at the prime of his life the cruel fate cut short the glorious creative career of this self-taught and self-made man. Generations of Mathematicians have been and will continue to be inspired and follow in the footsteps of Srinivasa Ramanujan —the Jewel Amongst Mathematicians.

1987 was celebrated as Ramanujan's Centenary year whose contribution in some areas is considered no less than that of the great mathematicians like Leonard Euler and Jacoby. The best way to pay homage to this great mathematician of our land is to take his thoughts and work to the classroom in as simple a form as possible so that our pupils relive and reconstruct his ideas and work.

Ramanujan's Date of Birth Magic Square

22	12	18	87
21	84	32	2
92	16	7	24
4	27	82	26

How Good Are You in Science ?

Smriti Sood
Pradeep Tiwari

J.P F., D.E.S.M.,
NCERT, New Delhi

Tick mark the Correct Answer

1. The bird that never makes its nest is —
   a) crow b) baya c) sparrow d) cuckoo

2. Which of the following organs is responsible for oxygenation of blood —
   a) kidney b) heart c) liver d) lung

3. Which of the following diseases is connected with liver —
   a) jaundice b) myopia
   c) cataract d) ringworms

4. William Harvey's name is associated with the discovery of —
   a) Rh factor
   b) blood groups
   c) laws of genetics
   d) circulation of blood

5. Deficiency of Iodine in the diet causes —
   a) ricket b) beriberi
   c) goitre d) night blindness

6. Hardest substance found in man is —
   a) bone b) cartilage
   c) enamel of teeth d) tendon

7. Which of the following organelles is known as power house of a Cell —
   a) chloroplast b) mitochondria
   c) lysosome d) dictyosome

8. 'An origin of species by natural selection' was written by —
   a) Darwin b) Lamark
   c) Robert Hooke d) Devries

9. The symbiotic association between an algae and a fungus is termed as —
   a) moss b) fern c) pinus d) lichen

10. Which of the following is not a salivary gland —
    a) parotid b) submaxillary
    c) lingual d) Brunner's gland

11. The enzyme which coagulates milk is —
    a) pepsin b) renin c) trypsin d) lactase

12. Vitamin C is chemically known as —
    a) asparitic acid b) citric acid c) ascorbic acid d) tartaric acid

13. Light year is the unit of —
    a) velocity b) distance
    c) light intensity d) time

14. In the Einstein equation $E=mc^2$ "c" denotes —
    a) velocity of sound
    b) wavelength of the light
    c) velocity of light
    d) refractive index of the medium

15. When iron rusts its weight —
    a) increases
    b) decreases
    c) remains the same
    d) first increases and then decreases

16. Galena is an ore of —
    a) zinc b) lead c) iron d) copper

17. The doctor checks the pulse for an idea of —
    a) temperature b) blood pressure
    c) heart beat d) respiration rate

18. Common household sugar is —
    a) glucose b) galactose
    c) maltose d) sucrose

19. One quintal is equivalent to —
    a) 10 kg b) 50 kg.
    c) 1000 kg d) 100 kg

20. Isotopes of an element have the same —
    a) atomic mass b) atomic number
    c) density d) atomic wt

21. Which one of the following is a polysaccharide —
    a) glucose b) fructose
    c) sucrose d) cellulose

22. The lightest of all gases is —
    a) hydrogen b) helium
    c) oxygen d) nitrogen

23. The edible part of an apple is the —
    a) thalamus b) epicarp
    c) endocarp d) mesocarp

24. The first life forms on the earth originated —
    a) in water b) on land
    c) on mountain d) in the air

25. Which of the following types of teeth help in piercing the food —
    a) molar b) premolar
    c) incisors d) canines

26. Which of the following animals is a hermaphrodite —
    a) Fish b) Earthworm
    c) Butterfly d) Amoeba

27. Red blood cell in mammals contain —
    a) nucleus b) plastid
    c) haemoglobin d) bacteria

28. Which of the following pair is incorrect —
    a) kiwi—bird b) alligator—amphibian
    c) bat—mammal d) fish—pisces

29. Which lens is used to correct the defect of short sightedness —
    a) convex b) concave
    c) plane glass d) plano convex

30. Brass is an alloy of copper and —
    a) zinc b) almunium
    c) sodium d) magnesium

ANSWERS

1. (d) 2. (d) 3 (a) 4. (d) 5. (c) 6. (c) 7. (b) 8. (a) 9. (d) 10. (d) 11. (b) 12. (c) 13. (b) 14. (c) 15. (a) 16. (b) 17. (c) 18. (d) 19 (d) 20. (b) 21. (d) 22. (a) 23. (a) 24. (a) 25. (d) 26. (b) 27. (c) 28. (b) 29. (b) 30. (a).

News Feature

Nobel Prize in Sciences

Physics and Chemistry

George Bednorz of West Germany and K. Alex Mueller of Switzerland were awarded the Nobel Prize in Physics for discovery of new superconducting materials.

A French researcher, Jean-Marie Lehn, shared the the Chemistry prize with Donald J. Cram and Charles J. Pedersen of the United States for work in the synthesis of molecules that can mimic important biological processes.

The winners of the physics prize, Mr. Bednorz 37, and Mr. Muller, 60, are researchers at the IBM Zurich Research Laboratory in Switzerland.

The Chemistry research by Mr. Cram, 68, Mr. Lehn, 48, and Mr. Pedersen, 83 could be used to separate radioactive tissues from other tissues and for the purification of molecules. It also may have future application in energy production.

In announcing the Chemistry prize, the Royal Swedish Academy of Sciences cited the researchers' work in making relatively uncomplicated compounds that perform the same functions as natural proteins.

The awards committee said that "great progress" toward "this goal" had been made in the last 20 years, "and it is the pioneering achievements in this particular area that are now being recognized."

The committee said the scientists' work laid the foundation for an area of research that has become known as "host-guest chemistry" or "supiamolecular chemisitry".

"At the basis of many biological processes lies the ability of molecules to recognize each other and to form well-defined complex," the announcement said. "In most cases, one or more compounds of low molecular weight bind to a specific region in a high-molecular-weight compound, most often a protein on a nucleic acid. The binding is very specific and selective, and the low-molecular-weight compound must fit the high like a key in a lock "

Two works published by Mr. Pedersen in 1967 became classics in the field, while Mr. Lehn and Mr. Cram later built on his studies, the announcement said.

"Pedersen, Lehn and Cram laid the foundations of what is today one of the most active and expanding fields of chemical research," the committee said "The goal is to produce synthetic host molecules that recognize biologically active molecules. Thus Lehn has produced a host molecule for the single substance acetylcholine, which is so important in humans and animals."

Nerve cells use acetylcholine to communicate with each other.

Mr. Cram has been a professor at the University of California at Los Angeles since 1947. A native of Chester, Vermont, he earned his doctorate at Harvard University.

Mr. Pedersen was born in Fusan, Korea. He was a Norwegian citizen until 1953, when he took U.S. citizenship. He earned a master's

degree at the Massachusetts Institute of Technology and worked as a research chemist for Du Pont Co. from 1927 until his retirement in 1969.

Mr. Lehn, who lives in Paris, has been a chemistry professor at the Universite Louis Pasteur in Strasbourg, France, since 1970 and at the College de France in Paris since 1979.

The announcement by the Swedish Academy cited the "important breakthrough" of Mr. Bednorz and Mr. Mueller, winners of the physics prize, "in the discovery of superconductivity in ceramic materials."

Last year, the announcement said, the two "reported finding superconductivity in an oxide material" at a temperature 12 degrees centigrade (53 degrees Fahrenheit) higher than previously was known.

Scientists had been trying to raise that temperature for more than a decade in an attempt to make wider use of superconductivity, which is the ability of some materials to conduct electricity without losing current to resistance

Standard superconductors are used now in limited high-tech application because they must be chilled at temperature well below 240 degrees below zero centigrade (400 degrees below zero Fahrenheit), an expensive process.

But the work of Mr Bednorz and Mr Muller pointed the way to new materials that become superconducting at higher temperatures Scientists hope that room-temperature superconductors eventually will be found.

Higher-temperature superconductors could open the door to faster computers, high-speed trains that float above their tracks and innovations in generation and transmission of electric power.

Superconductivity has a long Nobel prize history. It was discovered in 1911 by a Dutch physicist, Heike Kamerlingh Onnes, who received the prize in 1913.

The work of this year's winners "was the start of an avalanche," the awards committee said.

In contrast to the metal alloys used in standard superconductors, recent work is following the scientists' lead of using a combination of oxygen, copper, the element barium and a "rare earth," a misleading name for some common natural materials

Each Nobel award carries a cash prize of 2.17 million kronor ($340,000), which is divided if more than one laureate is named for each prize

Japanese Bags Award for Medicine

The Karolinska Institute in Stockholm announced that Japanese Molecular Biologist Susumu Tonegawa, currently a Professor at the Massachusetts Institute of Technology (MIT), would receive the 1987 Nobel Prize in Medicine for his discovery of "The Genetic Principle for Generation of Antibody Diversity." Tonegawa, 48, becomes the seventh Japanese to be awarded a Nobel prize and the first in the category of medicine.

In announcing the award, the Karolinska Institute stated that Tonegawa was making a major contribution to explain the "Unsolved puzzle" of how the body manufactures hundreds of millions of antibodies each targeted at an invading agent the body has never seen before. "Tonegawa's discoveries have increased our knowledge about the structure of our immune system," the Institute said. "They also open up possibilities to increase the immune response against pathogenic micro-organism through vaccination—and also to imporove inhibition of unwanted immune reactions."

Tonegawa was born in Nagoya, Japan, in 1939 and graduated from the science department of Kyoto university in 1963. After earning a doctorate at the University of California-San Diego and doing postgraduate work at the Salk Institute in San Diego, he became a

member of the Easel Institute for Immunology in Switzerland in 1971. In 1981 he became a professor at the Massachusetts Institute of Technology in Cambridge, Messachusetts, USA.

Tonegawa received Japan's order of culture for his contribution to progress in Genetics in 1984, the Bristol-Myers Award for distinguished achievement in cancer research in 1986, and the Albert Lasker Medical Research Award in September 1987.

Nobel Prize Remains Supreme

Baron Stig Ramel says of Nobel Prize: "It is the Olympic gold medal of intellectuals". More than 2,000 prizes are awarded around the world each year for scientific or artistic achievement, but the Director of Sweden's Nobel Foundation said in an interview: "We were the first in the field and we remain pre-eminent".

The will of Swedish dynamite inventor Alfred Nobel established five prizes—for physics, chemistry, medicine, literature and peace. They were awarded for the first time in 1901. The economics prize was added in 1969.

"Each winner in some sense inherits the prestige of his predecessors and so the prestige of the Nobels grows year by year", Ramel said.

So does the media hullabaloo surrounding the winners, who can be elevated from relative obscurity to media personalities and in some cases national heroes.

The Swedish Foreign Ministry estimates that around one-third of all the words written about Sweden in the world's press relate to the prizes, nearly all of them positive.

"For 10 months of the year, I'm in business, handling the Nobel funds from which the prize money—this year $337,000—is drawn", said Ramel.

"For the other two months, between the anouncement of the award and the actual prize-giving ceremonics in December, I'm in show business", he said.

The prize-giving ceremony and subsequent banquets in Oslo and Stockholm, once quiet affairs with a few dozen guests, have become elite social gathering with thousands of participants.

We are very proud of the prizes, like the British are proud of their royal family," said Mr. Bengt Feldreich, a journalist who for 25 years has hosted a round table discussion between the winners of the scientific prizes televised to eight European countries.

But he added · "It has definitely become much harder for the winners to handle themselves "From the moment the news is announced their normal lives are gone. They are swamped with requests for interviews or lectures. They can forget about work for months".

Social Implications

The winners have changed, too Twenty years ago, scientists were inclined to shun publicity and dismiss the idea that they should be concerned at the social implications of their work.

"Now, they are very aware of the need to inform the public of where science is heading and winning the prize gives them a unique opportunity to do that", said Mr. Feldreich. Winners may be asked for their views on subjects far outside their fields of expertise—"anything from shoe-laces to nuclear energy" as the 1981 medicine prize winner Roger Sperry put it.

In the case of one winner—the laureate for peace awarded by the Norwegian Nobel Institute—winning the prize may change his life forever.

"Winning the peace prize gives a unique

platform for people to pursue their cause Look at Bishop Desmond Tutu (winner in 1984). The prize made him a world personality" said Ramel.

Other peace prize awards have been more controversial The 1963 choice of the U.S. Secretary of State, Mr Henry Kissinger, and North Vietnamese diplomat, Mr. Le Duc Tho for their efforts to end the Vietnam war was criticized. So was the 1978 prize award, to the Egyptian President, Mr. Anwar Sadat and the Israeli Prime Minister, Mr. Menachem Begin for negotiating an Israeli-Egyptian peace treaty.

The Nobel Selection Committee has never retracted a peace prize award or conceded it might have made a mistake, although earlier decisions have been criticized by newer committee members, said the Norwegian Nobel Institute Director, Mr Jakob Sverdrup

"But such criticism never goes beyond the committee room's four wall", he said.

"The committee also puts a lot of emphasis on research into candidates. And although some of the prizes have been controversial, the committee has generally picked the right winners in international terms'', he said

Ramel said : "There have been very few mistakes. The fact that scientists all over the world strive to win the prize shows how much it is valued among the professionals". He belives the prizes are a powerful force for good. "They go very well with what Sweden sees as its role in the world—to work for the development of mankind through science and the growth of international brotherhood and peace".

Apart from that, they are a welcome break in a world whose heroes are sportsmen and politicians. "Isn't it wonderful that once a year scientists and intellectuals are made heroes", he said ☐

Science News

Iodine Deficiency : a Solution at Hand

Immunization and ORT are universally relevant. But there are also low-cost solutions waiting to go into action in regions of the world with particular health problems.

The outstanding example is the iodation of salt to eradicate iodine deficiency disorders (IDD) which affect hundreds of millions of people in mountainous or flood-prone areas of Asia, Africa and Latin America where soil and therefore food are lacking in iodine. To iodate all the edible salt in India would cost less than one cup of tea per person per year. But it can eradicate a deficiency which lowers the productivity of millions of adults and irreparably damages the mental capacity and physical growth of hundreds of thousands of children.

Because the most obvious sign of iodine deficiency is goitre—the unsightly swelling of the thyroid gland in the throat—iodine deficiency was long considered a cosmetic problem. But in the 1950s and 1960s, pioneering work by researchers such as Dr. V. Ramalingaswami (now Director-General of the Indian Council of Medical Research) began to reveal what turned out to be little less than a horror story about the hidden effects of iodine deficiency.

The lack of iodine restricts the body's production of the hormone thyroxine. In adults, the result is physical sluggishness and lowered productivity which can be corrected by adding iodine to the diet In growing children, and in the unborn foetus, the result can be irreparable damage to the growth of brain, body, and central nervous system More recently, iodine deficiency has also been linked to a high incidence of spontaneous abortion, stillbirth, and infant mortality.

The result is that, in some villages, 15%—20% of children are born with brain damage and grow up both ineducable and unemployable. In pockets of iodine deficiency, a quarter of the population are deaf-mutes or have pronounced physical or mental disorders

Unlike most health problems, iodine deficiency has a 'centralized' scientific solution. Adding potassium iodate to salt in the proportion of the 80 to 100 parts per million is neither expensive nor technically difficult. But because the human body requires only a teaspoonful of iodine in a whole lifetime, this simple measure can eradicate iodine deficiency.

But there problems. Iodation adds fractionally to the cost of salt, and it is not always easy to convince people to pay more when the advantages are not widely known. Neither is it a simple matter to apply government regulations when there are so many people involved in producing, transporting, and marketing salt—and such fierce competition on price. And even after iodine has been added, it can leach out again because of poor storage and transport. But the biggest problems lie in convincing the authorities that this is a crucial problem with an available low-cost solution—and in convincing large numbers of people to buy only iodated salt and to store it properly.

In some regions, the power of salt iodation has already been dramatically demonstrated. China, for example, has reduced the prevalence of goitre in Jixian county from 65% in 1978 to 4% in 1986 : earnings have increased tenfold and not a single child has been born a cretain in a village previously known for its high rates of mental retardation. Similarly, in one area of the kingdom of Bhutan, the percentage of children born with iodine deficiency fell from 10% to 1% within one year of salt iodation.

Last year, the International Council for the Control of Iodine Deficiency Disorders was set up to promote the eradication of IDD and to share the experiences of those countries which have already launched IDD control programmes If these efforts get the political backing they need, and if the public becomes more informed about the iodine issue, then there is no doubt that one of the most tragic and unnecessary of all health problems can be eradicated by the end of this century.

New Encyclopedia of World Problems Published

Encyclopedias in general are reference books that treat comprehensively all the various branches of knowledge. It is a place to go to extract information about anything say, from the extinction of dinosaurs to the history of Western colonialism.

Now, the Union of International Associations based in Brussels, Belgium, has published a unique 1440 page work called the *Encyclopedia of World Problems and Human Potential* that arranges information in a thought-provoking and challenging manner, unlike any other reference work available

Well over 10,000 world problems reported by thousands of international organizations are presented, and the question the *Encylopedia* asks is "Which of these problems really exists?"

The ambitious publication deliberately juxtaposes contradictory perceptions about the world's problems The editors argue that by presenting fundamentally incompatible viewpoints within the same context, they will challenge the reader to discover new approaches to understanding and action.

Highly controversial "problems" such as capitalism and communism are therefore included with appropriate counter-arguments to reflect the nature of intellectual debate

The book may therefore be considered as a collection of the biases active in the international community, and aims to provide an overview of the world's fears, whether real or imaginary, that inspire or undermine collective initiatives

The range of problems described is enormous It includes such topics as Incompetence, Soil Erosion, Acid Rain, Loneliness, Protectionism, Food Grain Spoilage, Forced Labour, Illiteracy, Natural Disasters, Homelessness, Armaments, Corruption and much more.

Extensively indexed and cross-referenced, the *Encyclopedia* succeeds in describing patterns and relationships characteristic neither of usual specialized perceptions, nor of the policies and institutions that have become barriers to international change.

In contrast to the many efforts to name "the key problem" or "the key solution"—magically appropriate to all the world's ills—the editors consider that, if anything, it is precisely that mode of thinking which is itself the key problem.

The *Encyclopedia of World Problems and Human Potential* costs US$200, with discounts of 50% available under certain conditions. A ten-page summary is also available for inspection.

"Barefoot Doctors" and Oral Rehydration

While diarrhoeal disease among Chinese children is as prevalent as in many Third

World countries, the number of children who die as a result has remained low.

Now researchers think they know why. The nation's "barefoot doctors" have been administering an oral rehydration solution for at least 20 years.

According to the results of a Ministry of Public Health/UNICEF survey in 10 counties, 91% of the 131 "barefoot doctors" surveyed said they used a salt, sugar and water solution to treat diarrhoea.

The common practice was to add salt to water until the solution tasted salty and then to add sugar until it became sweet. Yet because a precise combination of sugar, salt and water is important for the solution to be effective, a corrective educational programme is now underway.

Vitamin A May Promote Child Survival

Recent field studies have shown that Vitamin A supplementation dramatically promotes the survival of the most vulnerable young children, according to Dr. Nicholas Cohen of the Xerophthalmia Club

A landmark study by Alfred Sommer of Johns Hopkins University based on design trials in Java, Indonesia, suggests that childhood mortality is powerfully influenced by Vitamin A status, perhaps to a large extent independently of general nutrition. If true and widely acceptable, says Dr Cohen, a policy of being able to alter the whole picture of child survival in the face of malnutrition by simply providing a single vitamin has immense implications.

Although arguments for urgent action are already convincing as Vitamin A can help prevent blindness, Dr. Cohen cautions against using these findings until more experiments are carried out in high risk areas. Pilot projects should be undertaken where childhood mortality is high, no prior distribution of Vitamin A capsules has taken place, and good infranstructure exists to sustain the research.

"We now have added strength in the likelihood of some reduction in child mortality," Dr. Cohen said, "but we should be careful to overstate to health policy planners an already very powerful case."

History of Eradication of Smallpox

Before the end of this year, WHO Will publish a 1,500-page monograph which will be the definitive history of smallpox and of its eradication from the planet. The publication coincides with the tenth anniversary of the finding—in Somalia—of the World's last case of smallpox

It includes chapters written by F. Fenner, D.A. Henderson, I Arita, Z Jezek and I.D Ladnyi, who were all intimately involved in the intenational effort to wipe out the disease and to prove to the world that it had been eradicated. The 31 chapters of this monumental work describe this now-extinct disease, its virology, pathology, immunology and epidemiology, and its history and the methods used to prevent it or mitigate its effect from ancient times to the very recent past It explains how the idea of wiping out smallpox germinated, and gives a step-by-step and country-by country account of the successes and occasional setbacks during the intensified programme for its eradication from 1967 to 1977 Finally, it explains the rigorous system of certification instituted by WHO which ensured that one part of the globe after another could be declared a smallpox-free zone until, in May 1980—some 180 years after Edward Jenner forecast that his newly-discovered vaccine must result in the annihilation of the disease—the World Health Assembly was able formally to declare that smallpox had been eradicated.

Entitled "Smallpox and its Eradication," the monograph is profusely illustrated with

colour plates and black-and-white pictures, and can be ordered from · Distribution and Sales, WHO, 1211 Geneva 27, Switzerland.

Solar Energy Modules

The Soviet scientists have divised some highly efficient solar energy modules for solar power stations, original in design, inexpensive and free from the drawbacks found in the existing ones The efficiency of one model is said to be as high as 70% which is two times higher than that of the best sunlight collector now available.

The module, designed by the Quant Research aud Production Association, is of a tubular type combining the merits of a prismacon and a cylindrical concentrator, and uses the complete internal reflection principal. A sunbeam is literally trapped in it. The refractive index of the material from which the concentrator is made has been so chosen that the beam cannot escape The beam has only one path—towards the collecting face where a sunlight collector is placed.

The module uses selective translucent coatings which allow visible light to pass through them and reflect infrared beams. Thus the heat released while light passes through the concentrator material is not lost It can be deviated by a heat-transfer agent and utilized. The whole module is in a state of vacuum which rules out losses due to the heating of surrounding air.

The sunlight collector in this module is complex The silicon photocell which is cooled by the heat-transfer agent operates in an optimum electric mode.

A second module combines the advantages of Fresnel lenses and hyperbolic counter-reflectors. But it needs discrete sun tracking of low accuracy. The capacity of the devices where these modules are used makes it possible to spend a portion of the energy on the collectors' rotation To reduce the share of this energy the module is maximally compact. This has been achieved by combining the sunlight collector with the centre of gravity of the device and by using a hyperbolic counter-reflector.

Devices with such modules are now being tested in Armenia and Central Asia

Sinking Volcano Located in Andaman Sea

The Geological Survey of India has located a sinking volcano in the Andaman Sea.

The submerged conical volcano which is believed to have sunk more than 600 metres since its evolution, was discovered by a survey ship of the GSI *Samudra Manthan*, in March during a six-day cruise.

The survey around Narcondam Island revealed the presence of a sinuous, submerged volcanic ridge, 16 km. east of the island.

The off-shore Mineral Exploration wing of GSI also identified a small conical sea mount with its peak lying 600-metres below sea level.

The volcano, topped by manganiferous coralline material in silty clay, has yielded a number of mineralized materials like calcite, haematite and felspar.

By analogy with large shield volcanoes of the Hawaiian chain the survey team surmized that the volcanic ridges might not have taken more than 1.5 million years to form.

The Sun is 4,600 M. Years Old

The sun is 1400 million years younger than scientists believed previously, according to data presented by Indian astrophysicists at an international conference on cosmic rays in Moscow.

Professor Badanawal Shrikantan told the conference that the sun was 4,600 million years

old. Previously the sun was thought to have existed for 6,000 million years.

Prof. Shrikantan, Director of the Bombay Institute for Problems of Physics, had used research into gamma rays emitted from the sun to revise the age estimate

Ancient Clay Tubes Found

Terracotta Tuyeres dating back to around 500 B C. have been unearthed by a team of archaeologists in Ellappatti village in Tamil Nadu making it evident that iron was used extensively by Megalith builders—identified with ancient Dravidians

Terracotta Tuyeres (clay tubes used for iron smelting) have also been found in Salem district. This showed that iron smelting industry was widespread in Tamil Nadu

The team from the State Archaeological Department which is surveying the Vaigal River bed has also discovered microliths (about 7,000 years old stone) Urn-burials and cist-burials belonging to 500 B.C have also been found along the river bed settlements.

Figure-Crazy Women Hit by Bulimia

The widely propagated idead of the slim figure usually triggers bulima, an illness which often leads to suicide. This warning is given by a group of West German doctors and psychologists who studied this new illness, suffered by women who force themselves to become slim

Women develop eating disorders due to the pressure created by the concept that slenderness means attractiveness and succes, the report says A second contributing factor is that the women concerned are incapable of sorting out their streess related problems, professional or personal in a reasonable manner Insted, they tend to "drown" these problems in a sea of food.

The team, led by Dr. Karl Martin Pirke of the Max-Planck-Institute for Psychiatry in Munich, has done research on the biological changes linked with "bulimia" and developed a behavioural therapy to teach bulimia patients how to eat normally again

In some cases an examination of the patients revealed serious physical symptoms Constant dieting and vomiting lead to loss of electrolyte in the body, particularly the loss of potassium. This, in turn, may result in cardiac disturbances and, in extreme cases, in cardiac arrest

The research revealed that more than 95% of the patients suffer from circulatory defects. Although the menstrual cycle seems to be normal, it is so disturbed that infertility may occur In addition, the gastric muscles slacken to the point where a danger of stomach performation exists □

Indian Educational Review

A Quarterly Journal of Educational Research

Indian Educational Review, being published by NCERT, is one of the top journals in the field of educational research in India. The journal has a balanced coverage, including articles on all aspects of education and different fields of educational research, with a definite bias for problems relating to Indian education

Indian Educational Review contains research articles, research notes, book reviews, Ph D theses abstracts, materials on new horizons and other feature articles. The areas covered by the journal include sociology of education, economics of education, philosophy and history of education, comparative education, educational technology, work-experience and vocationalization, science and humanities, teacher education, educational psychology and such other allied subjects which have relevance to the Indian situation

Further details may be obtained from

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